# Compressed Air Magazine



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## EDITORIAL CONTENTS



## ADVERTISING INDEX



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### ON THE COVER

OUR cover picture shows a Martin PBM Mariner seaplane being warped into a newly designed Navy floating dock at Port Hueneme, Calif. Another view and a description of the slip are on Page 40.

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### IN THIS ISSUE

THREE quarters of a century ago, the Caribou Mine, high up on the Continental Divide in Colorado, was pouring out wealth in the form of silver ore. The demonetization of silver dealt it a body blow, and two disastrous fires leveled the sizable community that had grown up there. During the intervening years, when highly volatile silver prices have been favorable, sporadic efforts have been made to rehabilitate the mine, and it has enjoyed brief prosperous periods only to close again when adverse economic conditions returned. Now a new attempt to revive it is being made, this time by driving a long tunnel to intercept the ore bodies at a relatively low level. Reduced mining and transportation costs and fewer difficulties from formidable alpine weather are the advantages of this method of attack. The colorful story of Caribou is told in our leading article.

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MINES sometimes store compressed air in chambers formed by blocking off ends of underground workings. Swedish operators have added something to this scheme by using water under a head to maintain the pressure as air is withdrawn. Details of several of these hydraulic air receivers are covered in the article that starts on Page 30.

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A NEW effort to develop commercial engines operated by the expansive force of compressed air seems to be meeting with some success abroad. A history of the air-engine idea and details of the current development are presented on Page 38.

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A CONTINUOUSLY operating mash cooler that works on the same principle as water-vapor refrigeration machines is being used effectively at the Hiram Walker distillery. Page 34.

# Old Colorado Silver Mine Being Reopened

L. A. Luther

PHOTO BY DON KEMP

**IDAHO TUNNEL**

Ample evidence of former activity is seen in the foreground of the view at the top. The building houses compressors and blacksmith equipment. The tunnel portal, left of it, has a sheet-metal extension as a protection against drifting snow. Underground view shows the front end of the drill carriage with its four DA-35 power-feed drifter drills.

ADVERSE economical conditions have closed many mines that were once highly profitable, but the good ones, like famous dramas, rarely die. From time to time, until they have yielded all their ore, they are revived, just as great plays are reopened periodically, and in both cases the personnel often changes with each new era of activity. Silver mines have been especially susceptible to varying degrees of fortune, chiefly because the price of the metal has fluctuated widely.

The current United States rate of more than 90 cents an ounce for newly mined silver has reawakened interest in silver camps, and among the properties being rehabilitated is the 88-year-old Caribou Mine, located high on the eastern slope of the Continental Divide in Colorado, 32 miles west of Boulder and 5 miles from the village of Nederland. There a new concern, Consolidated Caribou Silver Mines, Incorporated, is driving a tunnel to intercept the ore bodies and to set up more favorable conditions of mining than existed during former periods of operation when all material extracted had to be hoisted several hundred feet higher than the tunnel portal through shafts whose collars are at altitudes exceeding 10,000 feet. Aside from the prevailing favorable silver price, the venture has a number of things in its favor. In addition to improved transportation facilities, there are the metal-recovery processes and the more effective equipment for drilling and loading rock

**CARIBOU, PAST AND PRESENT**
Caribou was populous, though probably not at its peak when the picture at the left was taken. Many of the buildings had pole props to help them withstand the gales that sweep this near-timberline section. The view below shows all that remains of the town, which suffered two disastrous fires and was never rebuilt.

that have come along in recent decades.

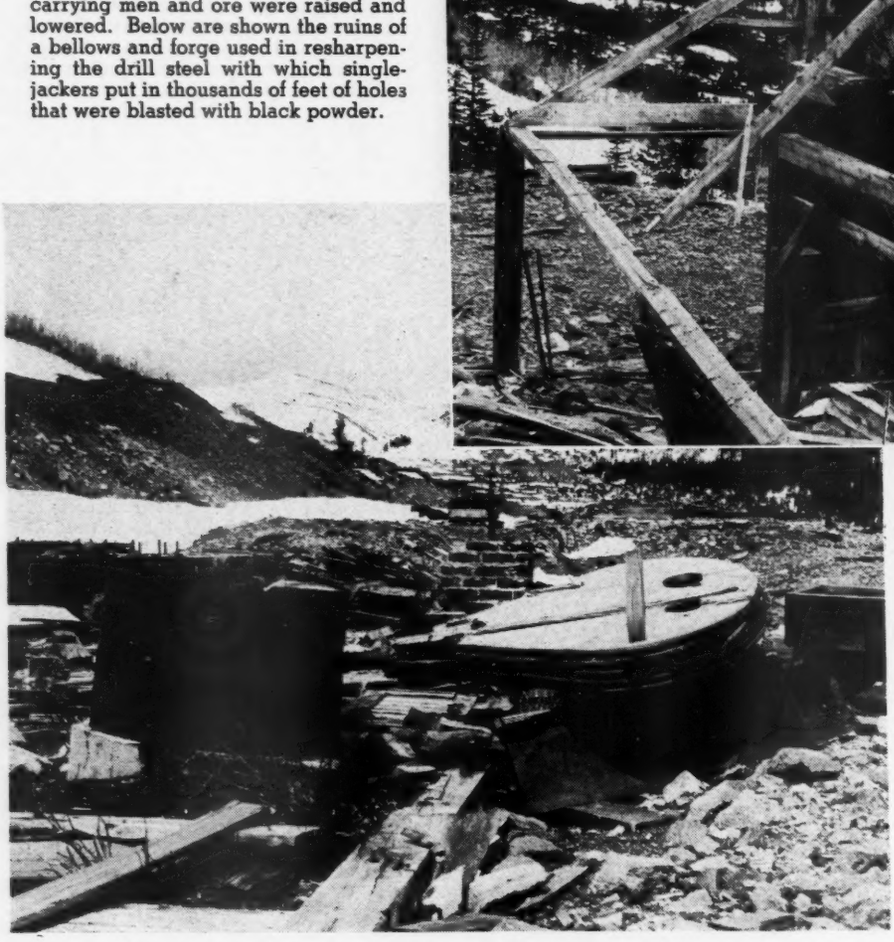
As has been true of many mines, the Caribou was discovered largely by chance. Furthermore, its finder, Sam Conger, didn't know for some years just what he had stumbled across. Legend has it that Conger, roaming the high hills in the dual role of prospector and hunter, was intrigued by the handsome silver ornaments worn by the Arapaho Indians that lived in that section. They refused to reveal the source of the metal, but he continued to search for it even after the Arapahoes had been evacuated from the area and placed on a reservation. He was hampered by the fact that he, in common with most prospectors of the time, could not identify silver ore; in fact, the quest was primarily for gold. Thus it happened that Conger wasn't aware of the nature or value of a vein of black metallic mineral that he noticed when hunting elk high up on Caribou Mountain in 1860. But he remembered what it looked like. Eight years later, while at the Union Pacific freight station in Cheyenne, Wyo., he saw something closely resembling it in a broken box containing rich silver ore that was being shipped east from the Great Comstock Lode in Nevada.

Upon being thus enlightened, Conger reasoned that he had something of a silver lode himself if only he could relocate it far up near timberline. Although the season of deep snows and howling blizzards was approaching, he immediately set out for Caribou Mountain and spent much of the winter there alone with just a tent for shelter and a prospector's fever to keep him warm. Eventually he found the vein, which later proved to be the richest of several discovered in the area. He filed on his claim and returned with five partners to take out the first load of ore. The nearest road of any sort was 4 miles away, making transport over rugged terrain perhaps a greater problem than mining, but returns from the first shipment provided all six of the party with a healthy grubstake and started a rush of prospectors into the section.

Conger subsequently traded his interest in the Caribou for full title to the Poorman, a neighboring claim, the workings and dumps of which also are currently owned by Consolidated Caribou. The Poorman was held for a time by a syndicate whose president was H. A. W. Tabor, builder of Leadville's and Denver's pioneer opera houses and perhaps Colorado's most colorful citizen. To Sam Conger's keen eye and inquiring mind are likewise attributed the discovery that "that damned black iron," always hated and cursed by miners in Boulder County, was in fact excellent tungsten ore essential to the manufacture of armament. Limited domestic supplies created booms in the mining and milling of tungsten in the Nederland area during both world wars. Conger is said to have taken a tidy fortune out of his silver-veined mountain; to have lost it in subsequent ventures; and to have "treated the two imposters, fortune and disaster, just the same" by living nearly to the century mark as a cheerful and popular member of his community.

Some $20,000,000 in silver is credited to the various operations initiated by the Conger strike, of which the Caribou contributed about $8,000,000. The district consists in general of massive gneiss and infiltrated schist, through which intrusive monzonite has broken to form Caribou Mountain. The veins in the monzonite are of true fissure type, and concentrations at points of intersection have accounted for the best ore.

In 1879 the Caribou Mine was developed by seven shafts with a combined depth of 2200 feet and all connected at thirteen separate levels by workings having a total length of 5000 feet. Scant data are available on the efficiency of the hand-drilling and black-powder methods that produced such vast quantities of rock, which was hard and seamed with iron dikes. In a description of the excavating of the Idaho Shaft it is stated that $60,000 in values was taken out in one month's progress of 20 feet, from which fact it is possible to gather that



**MACHINERY OF THE 1870'S**
The headframe of an old shaft has rotted away (right) to expose the wooden drum of a hoist by which buckets carrying men and ore were raised and lowered. Below are shown the ruins of a bellows and forge used in resharpening the drill steel with which single-jackers put in thousands of feet of holes that were blasted with black powder.

only inches of advance were made per day.

An operator named Breed bought a half interest in the Caribou for $50,000 in 1870, and the mine is reputed to have yielded $70,000 the ensuing year. Breed built a 15-ton concentrating mill on Middle Boulder Creek in 1872 to treat the ore by the chloridization-amalgamation process. The ore was crushed in a 40-ton Blake crusher, passed under fifteen 750-pound stamps, and fed to four Bruckner cylinders, with a capacity of 3500 pounds each, where it was roasted by wood firing for from eight to ten hours. Some 8 to 10 pounds of salt was added for each 100 pounds of ore near the middle of the roasting period.

The roasted pulp was transferred to mullers, 400 to 500 pounds of mercury put in each 2000-2500 pound batch, and the charge ground for from ten to twelve hours. Enough water was introduced to permit the amalgam to settle, and tailings were decanted. The amalgam was retorted to drive off and recover the quicksilver, and the silver was melted and poured into bricks. These 200-pound ingots were the source of much local wonder and pride and of much good publicity for the Caribou-Nederland area. A load of the shining bars, loaned to Central City, formed a walkway from the unpaved street to the front door of the Teller House for President U. S. Grant when he alighted there from the Denver stagecoach while on a visit to Colorado's leading mining metropolis in 1873.

It may be readily understood that this spotlighting of the district was no handicap to Breed when a group of "gentlemen from The Hague" began dickering for the mine in 1873, the year that silver was demonetized. When they purchased the Caribou for $3,000,000 a record was set in Colorado mining transactions, for it was the first mine to sell for more than a million. Breed appears to have been a cautious and hard bargainer, because he sold with the stipulation that he was to retain title and continue mining until he had received the full purchase price. This is reported to have required approximately a year, during which time the mine produced $900,000. The new owners, incorporated as the Mining Company of Nederland, left a memento in the name of the village of Nederland.

Old residents recall the day when no road came up from Boulder and when all traffic from Denver traveled the circuitous Blackhawk-Central City route. Nederland with four livery stables and some hundred-odd head of livestock, was then a way station engaged in freighting. The haulage rate from Denver to Nederland is said to have been $15 a ton. The Dutch owners of the Caribou recruited experienced miners from Cornwall, and some of their descendants are now employed by Consolidated Caribou.

The town of Caribou grew to a peak population of more than 3000. Old records show that snow sometimes drifted to the second-story windows of the 3-story Sherman House and that tunnels were driven through it for the guests. Fire took heavy tolls on two occasions, and little now remains except a few masonry walls. Epidemics of diphtheria and scarlet fever seem to have been particularly virulent at the high altitude, and the cemetery—with its exquisitely sculptured marble headstones shipped from Great Britain and where snow drifts over mortised wood fences nine months of the year—is the most tangible reminder that community life once flourished nearby.

The Caribou Mine did not prosper under Dutch management, and controversy and litigation arose over conflicting claims as a result of the extension of the many underground workings in the mountain. When the Dutch withdrew, Jerome B. Chaffee, who was later a U.S. Senator, took over and for some time maintained a payroll of from $12,000 to $15,000 a month. So magnificent was the display of ores sent from there to the Boston Centennial in 1876 that much attention was focused on the "silver capital."

But the mine could not keep going in the face of silver demonetization and other economic drawbacks, and it gradually closed down. There followed a long period of inactivity during which the town dwindled almost to the point of desertion. Aside from sporadic, small-scale operations, the property remained dormant until the World War I period, when it was purchased by J. G. Clark of Boulder. Following a complete geologic examination in 1917, he formulated two plans for tunneling into the mountainside to intercept the vein system far below the shaft collars. On one of these bores—the Idaho—he did considerable work. Later, upon acquiring the partially completed Boulder County Tunnel at a lower elevation than the Idaho, he decided to lengthen it and strike the ore at an altitude of 8500 feet, or 1500 feet below the collar of the main shaft.

Before beginning present operations, the first at the mine since 1928, Consolidated Caribou obtained other neighboring properties. Rehabilitation and enlargement of some 1500 feet of the old Idaho Tunnel was begun on November 20, 1946. This job was completed on January 16, 1947, after which driving of an additional 2008 feet to the old workings was started. Up to January 1 of this year, 1944 feet of progress had been made. The 8x9-foot Idaho is approximately 600 feet below the collar of the main shaft. It will intercept the latter 5x15-foot, inclined, 3-compartment haulageway, which is to be dewatered and refitted to provide access for mining 640 feet below the tunnel level. A station in which to house hoisting machinery will be excavated at the junction with the shaft. When 3253 feet in, the bore intersected the old No Name Shaft, and in driving a by-pass around it, the workers unexpectedly tapped a silver-lead-gold ore body. The latter is now being mined.

The tunnel is being driven in two shifts, each completing a round that advances the heading an average of 6 feet. Seven-foot holes are drilled with four DA-35 power-feed drifters mounted on a track jumbo. The 1¼-inch steel and the Type 1 Jackbits used are reconditioned in the Denver shop of J. B. Pearce, the detachable bits being hot-milled. The number of holes per round, which varies from 30 to 38, and the choice of either a pyramid or burn cut depend upon the rock formation. Du Pont Gelex 45 percent dynamite is employed with 1 to 8 delay primers. Excavated material is loaded by means of an air-operated mucking machine, and cars are hauled by a storage-battery locomotive. A California switch serves to by-pass cars at the heading so as to put empties in loading position.

Compressed air is supplied by two Ingersoll-Rand Type 10 units, the receiver at the compressor house being supplemented by one interposed in the air-delivery line relatively close to the face. Three electric-driven b'owers, which may be reversed to exhaust air from the bore, are used for ventilation. Water for the drills is obtained from the old Idaho Shaft and pumped to a pressure tank suitably located in the tunnel. Only a small quantity of ground water has been encountered, and this was largely confined to the old tunnel sections. Spoil is dumped and leveled at the portal to build up needed working space.

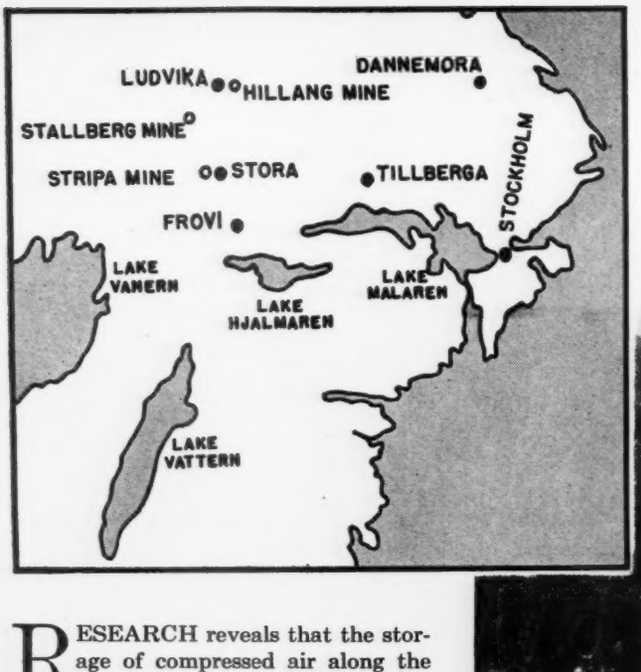
The product of the mine will have to be trucked approximately 5 miles to a mill built in 1942 to concentrate tungsten ore. It was recently bought by Consolidated Caribou and altered to permit handling silver ore. The mill is of the conventional flotation type, utilizing crushers, rolls, and rod mill. Reagents and the flow sheet used were developed by experimentation with material from the old Caribou dump. Analyses of samples from this and other dumps, including Conger's Poorman, indicate sufficient values to make hauling and milling profitable.

The president of Consolidated Caribou Silver Mines, Inc., is Boris Pregel, engineer and scientist who warned America nearly seven years ago of the efforts being made abroad to develop an atomic bomb. He urged the United States to acquire all available uranium ores and was among the first to furnish them for our Atom Bomb Project. During the war, Mr. Pregel was a consultant to the Army's Chief of Staff. He is the author of *Peacetime Uses of Atomic Energy* published in March, 1947.

Mr. Pregel's brother, Alexander Pregel, is the company's vice-president, Matthew Ollsen is general manager, Elmer Hetzer is mine superintendent, and W. D. Peregrine is mill superintendent. Dr. G. C. Ridland is geologist; and Dr. E. E. Wahlstrom, professor of geology at the University of Colorado, is consulting geologist. The company office is in Boulder, Colo.

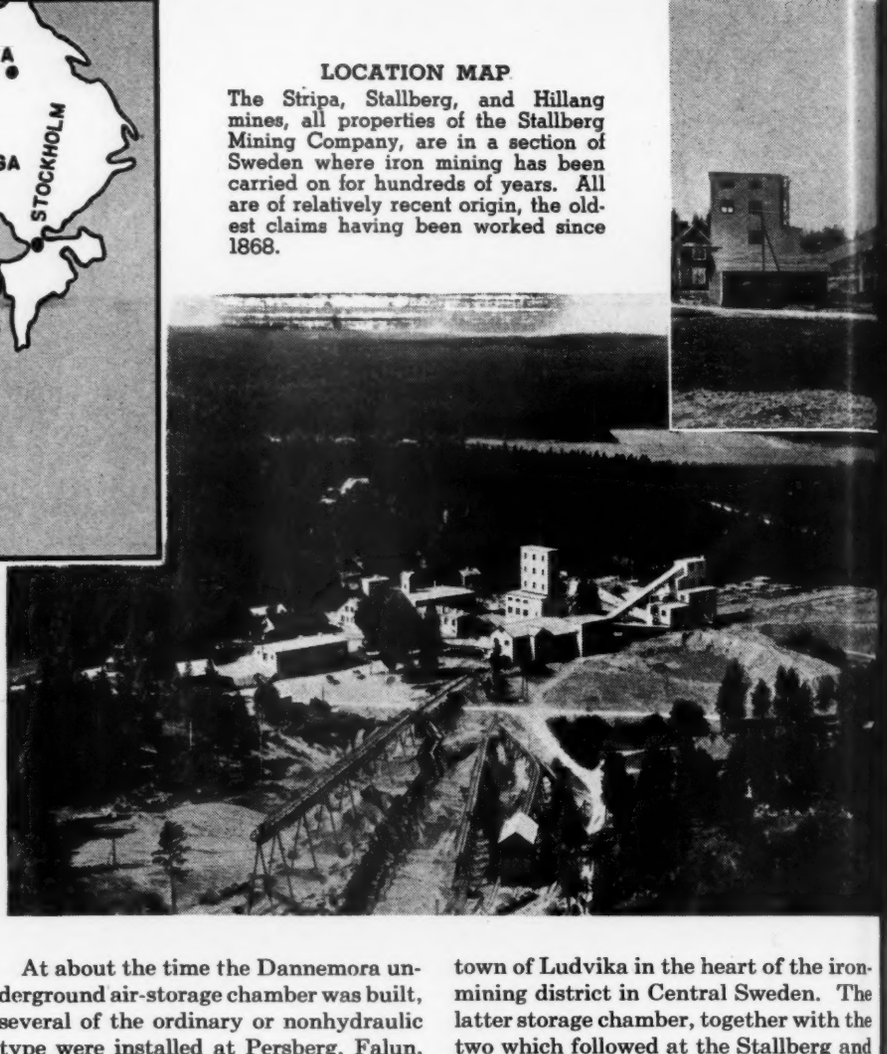
**A NEGLECTED CEMETERY**

Some of the beautifully carved headstones marking the graves of Cornish miners or members of their families were imported from England. The picture above was taken the day after Memorial Day, 1947. No flowers had been laid on the graves by human hands, but Nature was doing her best to atone for this oversight. Many were still covered with drifts, but delicate anemones (right) were blossoming amid the rocks as fast as the snow receded.




**LOCATION MAP**

The Stripa, Stallberg, and Hillang mines, all properties of the Stallberg Mining Company, are in a section of Sweden where iron mining has been carried on for hundreds of years. All are of relatively recent origin, the oldest claims having been worked since 1868.



RESEARCH reveals that the storage of compressed air along the lines of the method described in this article was first attempted in 1914 at the famous Dannemora mines in Central Sweden, which have been worked for more than 500 years. It is of interest to note that the first steam engine in that country was constructed at those mines in 1726. The man who pioneered hydraulic air storage there was the Swedish mining engineer Harry Nathorst. Instead of locating the entire plant below ground, as is modern practice, Nathorst used a nearby lake as the source of hydraulic pressure and placed the air chamber underground. The installation disclosed several fundamental weaknesses. The most serious of these was that, because of the nearness of the receiver to the surface, the overlying ground contained numerous fissures. In consequence, it was rather difficult to make the chamber airtight and there was considerable leakage.

At about the time the Dannemora underground air-storage chamber was built, several of the ordinary or nonhydraulic type were installed at Persberg, Falun, Grangesberg, and Striberg, the first two in connection with hydraulic compressors. However, the advantages of the hydraulic system were not recognized until after 1927 when the late mining engineer Elis Mossberg, with the help of Gustaf Jansson, a master mechanic, constructed one at the Hillang Mine near the little town of Ludvika in the heart of the iron-mining district in Central Sweden. The latter storage chamber, together with the two which followed at the Stallberg and Stripa mines in the same region, has become more or less the standard type. A few have been installed in recent years, the largest of which the author has knowledge being at Fosdalen, Norway, and having a volume of 140,000 cubic feet.

At the Hillang Mine, the first hydraulic air-storage system was designed in 1927 for 7 atmospheres (104 psi.) operating pressure and was rebuilt in 1929 for 11.6 atmospheres (171 psi.) maximum pressure. This involved relocating the air-storage chamber—placing it at a lower elevation than the original one. At the usual storage pressure of 155 psi., the receiver has a capacity equivalent to approximately 100,000 cubic feet of free air. The mine has been worked intermittently from about 1880 to 1917, and steadily since then. Annual production amounts to about 50,000 tons of manganiferous iron ore obtained by shrinkage stoping.

As can be seen in the accompanying drawing, the system consists of a drift on the 463-foot level that is connected by a short raise with an excavation in which air is kept under hydraulic pressure, and of a water-storage chamber located on the 72-foot level. The air receiver is separated from the drift by a

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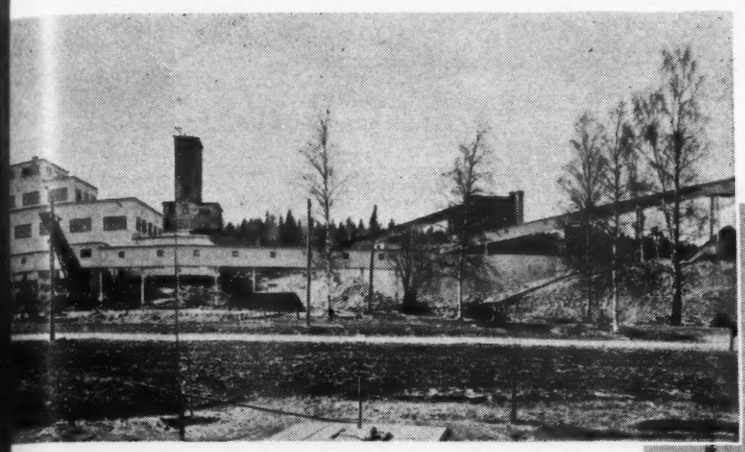
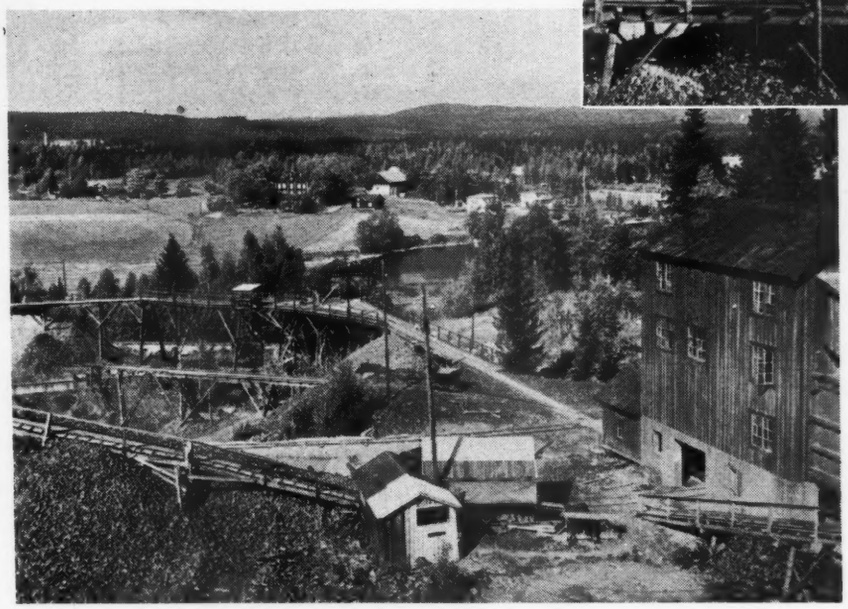
THE use of underground excavations as storage chambers for compressed air is not a new idea, yet it is virtually unknown in the United States. Of the few that have been built in this country none has, so far as we know, included hydraulic means for maintaining constant pressure, which is an essential feature of the installations described in the accompanying article. It is true that the hydraulic compressor, which entrapped air in falling water and compressed it by the weight of the descending column, had an underground receiver. But this chamber was an integral part of the compressor, as distinguished from an independent storage space. Mr. Dalhammer's account of the hydraulic storage of air as practiced in the iron-ore district of Central Sweden should therefore be of interest to mining men.

Mr. Dalhammer is a Swedish mining engineer and a member of the American Institute of Mining and Metallurgical Engineers. Following his graduation in 1933 from the Royal Technical Institute in Stockholm, he worked until 1937 for the Electrical Prospecting Company and the Swedish Diamond Drilling Company mainly in East and South Africa. Then he became assistant mining engineer of the Fagersta Steel Works in Sweden. In 1939 he was engaged as mining engineer for the Bastkarns Mining Company, an iron-ore producer in Central Sweden, and in 1940 accepted his present position of technical manager with the Stallberg Mining Company.



# Hydraulic Air-Storage Chambers in Swedish Mines

*Sven Dalhammer*



**SURFACE SCENES**

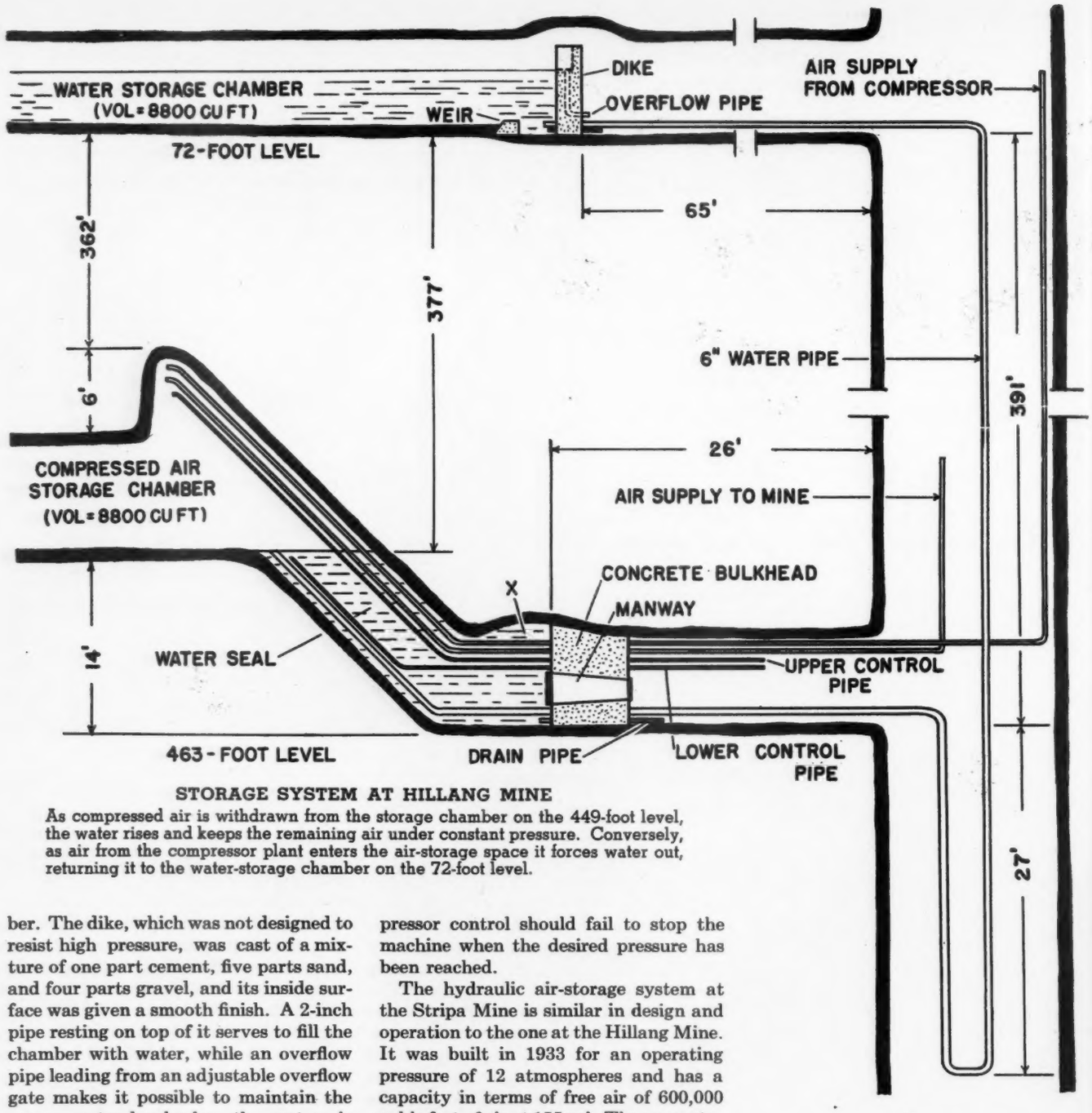
The mines are located in rolling, timbered country with interspersed farms. At the left is a general view of the Stripa Mine before the new mill was erected in 1943. The latter is seen at the top with the shaft headframe in the background. The latter was camouflaged during the recent war to forestall aerial attacks. The other two pictures show the headframe, miners' change house, and other surface structures of the Hillang Mine.

concrete bulkhead and a water seal. As air is pumped into it by the compressor, water is forced out and back up into its chamber. Conversely, when air is withdrawn for use in the mine, water descends and enters the air chamber, thus maintaining the prescribed pressure.

The concrete bulkhead which converts the excavation into a storage chamber is about 6 feet thick and contains an iron tube fitted at both ends with manhole covers to provide access. The inside diameter of this tube is 28 inches on the end nearest the air chamber and 20 inches at the far end. A 6-inch pipe from the water-storage chamber is carried down a shaft to a point below the 463-foot level, whence it extends through the bulkhead near the bottom and up the raise to the floor level of the air chamber, where it ends in a perforated sheet-steel funnel. Incoming and outgoing 4-inch air lines pass through the upper part of the bulkhead and terminate in elbows in a cut in the roof about 14 feet above the floor of the receiver. Other piping embedded in the bulkhead includes two ¾-inch lines for use in determining the water level. One of these ends at a point about 3 inches above the 6-inch water pipe, while the other terminates approximately 11 inches below the two air lines. A 1½-inch pipe permits the installation of an electric water gauge for control of the compressor; a 2-inch line serves to drain the chamber; and another ¾-inch pipe, not shown on the drawing, permits the bleeding of trapped air from the space marked X.

Support for the bulkhead is provided by cuts in the walls of the drift. These furnish added bearing surfaces and firmly anchor the heavy structure. It was poured of concrete made up of one part cement, two parts sand and gravel, one part shingle, and some stone, and is reinforced with 1¼-inch rods. A mixture of two parts cement and three parts sand was used to fill cracks and cavities in the rock for a distance of about 5 feet beyond the inner bulkhead face, which also was smoothed over with the same material.

The water-storage chamber consists of a drift that is partially blocked by a concrete dike. In the roof above it is a cut that allows inspection of the cham-




**STORAGE SYSTEM AT HILLANG MINE**

As compressed air is withdrawn from the storage chamber on the 449-foot level, the water rises and keeps the remaining air under constant pressure. Conversely, as air from the compressor plant enters the air-storage space it forces water out, returning it to the water-storage chamber on the 72-foot level.

ber. The dike, which was not designed to resist high pressure, was cast of a mixture of one part cement, five parts sand, and four parts gravel, and its inside surface was given a smooth finish. A 2-inch pipe resting on top of it serves to fill the chamber with water, while an overflow pipe leading from an adjustable overflow gate makes it possible to maintain the proper water level when the system is in use.

To make sure that the 6-inch conduit which carries water to the air chamber is full at all times, a small concrete weir was constructed a few feet back of the open end of the pipe and at a slightly higher elevation so as to keep it submerged and thus prevent air from entering. Consequently, there is no pressure drop in the air chamber such as would result if the water level were to sink so low that the pipe would be only partly filled. The section of the conduit that leads down to the air chamber extends for a distance of about 27 feet below the bottom of the 463-foot level and doubles back upon itself before entering that chamber. The purpose of this loop is to lessen the risk of air rushing into the water-storage chamber in case the compressor control should fail to stop the machine when the desired pressure has been reached.

The hydraulic air-storage system at the Stripa Mine is similar in design and operation to the one at the Hillang Mine. It was built in 1933 for an operating pressure of 12 atmospheres and has a capacity in terms of free air of 600,000 cubic feet of air at 155 psi. The property, which has been worked since the middle of the nineteenth century, produces a low-phosphorus (0.01) percent) quartz-striped hematite. Mining is done by the open room-and-pillar method with scraper loading, and the normal yearly output is approximately 150,000 tons of lump ore, or 70,000 tons of high-grade concentrate.

Originally, there was no loop on the end of the water pipe, because it was believed that the difference in elevation of 34.5 feet between the air chamber and the drift would prevent air from blowing back through the water pipe. It was found to be insufficient, however, so a loop was provided to increase the difference to 128 feet. No further trouble was then encountered. The capacity of the compressor which was first installed was 1100 cfm., but that unit was later replaced with one delivering 2200 cfm.

Low-phosphorus, manganiferous iron ore (5 percent Mn, 50 percent Fe, and 0.006 percent P) is obtained at the Stallberg Mine, which has been worked since 1868. The ore body is long and narrow, about 10 feet wide and 2500 feet long. and is very regular. The mining method used is shrinkage stoping with long-hole drilling. This is done both with diamond drills and with small stopers mounted on Jacklegs and using jointed steel with hard-metal bits. The latter set-up is the cheaper, but it cannot be used for holes longer than 45 feet because beyond that distance the steel deviates too much from its course. Present production at this mine is about 80,000 tons of ore per year, and the capacity of the hydraulic air-

storage system is 200,000 cubic feet of free air at an operating pressure of 155 psi.

Before a system such as that at the Hillang Mine is put in service, care must be taken to see that no pieces of wood or other refuse which might clog the piping are lying about in the air and water chambers. After this precaution has been taken, the raise and drift on the inner side of the bulkhead are filled with water from the storage space above. The height of this initial charge is determined by means of the lower of the two ¾-inch pipes previously mentioned. This serves to make the air chamber tight against leakage, and it must remain so at all times. Next, the latter chamber is tested with air at a pressure slightly higher than the proposed working pressure.

To determine the quantity of water that must be maintained in the topmost chamber to give the desired working pressure, the air receiver is filled with water until it runs out of the upper ¾-inch control pipe. When all that water has been forced back into the water-storage chamber by filling the air receiver with compressed air, then the overflow arrangement in the dike is adjusted so that the desired amount is in the water chamber. It is important that it should not be exceeded lest water reach the openings of the air pipes and enter the air-distribution system of the mine.

The difference in water level between the bottom of the water chamber and the roof of the air chamber—that is, when the air in the latter is exhausted—is about 368 feet, which results in a hydraulic or operating pressure of approximately 11.23 atmospheres (165 psi.). The difference in level between the overflow of the water chamber and the bottom of the air chamber—that is, when the air chamber is filled with air—is about 383 feet or 11.68 atmospheres (172 psi.), and the difference in level between the bottom of the air chamber and the lowest part of the 6-inch water pipe is about 41 feet or 1.25 atmospheres (18 psi.), In case the compressor control fails to function and pressure builds up in excess of $11.68 + 1.25 = 12.93$ atmospheres (190 psi.), the air in the storage chamber will begin to discharge through the water pipe into the water chamber, causing an overflow that may flood certain parts of the mine. Usually, about one-third of the water in the chamber is forced out into the mine, the rest going back into the air chamber.

In order to insure satisfactory performance of a hydraulic storage system, the air receiver must be excavated in solid rock. Of course, it may be possible to seal fissures in rock by grouting; but, obviously, it is preferable if this does not have to be done. Best results are generally obtained when the air chamber is located far underground. At one mine in Central Sweden, where fissured rock extends for a considerable depth below the surface, the air chamber was placed at about the 1500-foot level and was found to be practically airtight.

Mention has been made of the fact that Swedish mine operators use air at a maximum pressure of 155 psi. While this is not standard practice, drilling with high-pressure air is common. It does increase footage, but it also has drawbacks. We have found that pressure in excess of 120 psi. is hard on the modern rotating drill. Recent developments in tungsten-carbide bits will probably bring the operating pressure down to about 100 psi.

Hydraulic underground air storage has numerous advantages over conventional storage in steel tanks. The utilization of excavations that already exist as a result of previous mining operations permits constructing the facilities at moderate cost. Moreover, the storage capacity can be made of such a magnitude as to meet large requirements for working air, thus always insuring an adequate supply at an effective pressure regardless of the number of rock drills and other air-consuming tools or machines that are being run.

Because of the large storage capacity available, much of the air that is to be used during peak operating periods can be compressed at other times—generally at night when it is usually possible to buy power at a lower rate. Where this is not the case, night charging still affords a good opportunity to even out power consumption. Also, peak load can be leveled off by attaching a controller to the compressor to unload it when power consumption approaches that stage. Furthermore, a much smaller compressor can be used because of the leveling effect on air consumption. Finally, one always gets air at nearly constant pressure no matter how little is left in the storage chamber. This air is dry and cool, so helps considerably to increase rock-drill footage per shift.

The availability of a large storage space enables the Hillang Mine to take care of its compressed-air needs with one relatively small compressor. If it had only the small-capacity storage facilities of most mines, it would have to have several times the existing compressor capacity to meet the current air demand.

It is not unlikely that many mines have workings already excavated that would permit them to construct air-storage chambers of the hydraulic type at comparatively low cost. Of course, the plan is not feasible for general industries because they would have to dig their own "mines" to provide the physical facilities required.

**ENTRANCE TO AIR CHAMBER**

A view of the concrete bulkhead behind which compressed air is stored in the Stripa Mine. The pipe at the right leads to the overhead water chamber, and the two lines at the left carry air in and out. Below the latter, at the bulkhead, are two valves that permit draining water from the receiver and bleeding off any air trapped by water in the space immediately behind the bulkhead. A gauge at the upper right shows the air pressure in the chamber.

# Distillery Mash Cooled by Evaporation

CONTINUOUS and economical cooling of mash without the use of mechanical refrigeration has been achieved at the distillery of Hiram Walker & Sons, Inc., by the installation of a large-scale, multistage, evaporative cooler. Engineered to serve in place of double-pipe coolers, the unit is the first of its kind to be utilized for the cooling of mash.

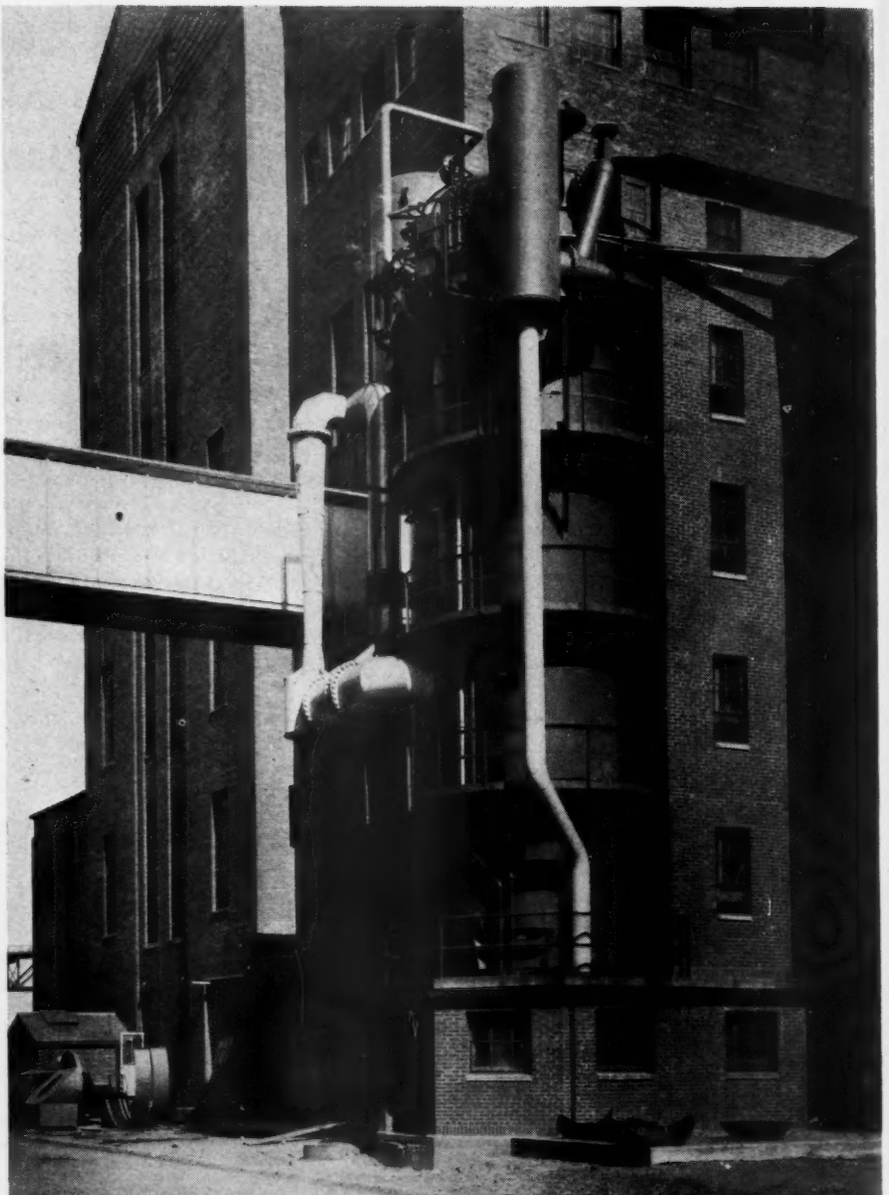
Located in Peoria, Ill., the Hiram Walker distillery is one of the largest and most modern in the world. Built in 1933, it contains the latest types of distilling apparatus and is capable of turning out 100,000 proof gallons of liquor a day. A highly trained technical personnel keeps close watch over each step in the process of whiskey making, once an art but now an exact science.

Grain brought into the distillery is weighed and cleaned before passing to mills which grind it to the desired fineness. The meal, mixed with water, is then cooked either in an open tub or in a pressure vessel. After the resultant mash has cooled, yeast is added and fermentation takes place. When the mash has fermented for the prescribed length of time it contains 6 to 8 percent of alcohol and is known as distiller's beer. The next stage is that of distillation, which separates the alcohol and aromatics from the beer, leaving a watery residue which is termed slop. Some of this is dried and sold as farm feed, while the remainder is used in diluting mash to the right consistency for fermentation.

Because both the mash and the slop are at a high temperature following the cooking and distillation processes, they must be cooled before the yeast can be added and fermentation begun. This was formerly done in a double-pipe cooler consisting of banks of 3-inch copper tubes inclosed in 5-inch iron pipes. While mash was being pumped through the copper tubes, cold water circulated in the opposite direction through the annular space between the pipes and the tubes. This set-up, although the job done was satisfactory, had a disadvantage: it required large quantities of cold water in summer as well as in winter.

The water was obtained from wells, and as the available supply was becoming inadequate, Hiram Walker engineers began seeking another means of cooling that could use river water. Investigations convinced them that a system that would evaporate some of the water in the mash and thereby exert a cooling effect on the mixture would be more economical and much simpler to operate than mechanical refrigeration. Specifications for such a system were accordingly prepared in 1939 and formed the basis for the apparatus that was subsequently developed through the joint efforts of the technical staffs of Ingersoll-Rand Company, Guardite Corporation, and Hiram Walker.

The orginal design was by Ingersoll-Rand, which first built a pilot plant that was operated for two months, using mash similar to that handled in the distillery. Guardite Corporation was awarded a contract to erect the cooler and all accessory equipment. Actual construction was postponed until 1943 because of wartime restrictions on the use of essential materials. Meanwhile, as a result of conferences held by engineers of the three interested concerns, refinements and improvements were made in the original design. As installed, the evaporator embodied in the cooler was built by Guardite, and the necessary ejectors, condensers, and pumps were



**GENERAL VIEW OF COOLER**

Rising more than five stories, the cooler is mostly outdoors, but all operating controls are inside the building. The central cylindrical shell is the evaporator, inside which the mash and slop are cooled in five successive stages as they descend from top to bottom. Vapors and noncondensable gases withdrawn from the evaporator are led to barometric condensers, of which there are two. The smaller of these, which serves the first two stages, is mounted on the near side of the unit with its tail pipe extending down to a hot well. Catwalks at various levels provide easy access to all parts of the equipment.

furnished by Ingersoll-Rand. Guardite supplied the controls and other accessories and took care of all details of erection. The cooler was put in operation early in 1945.

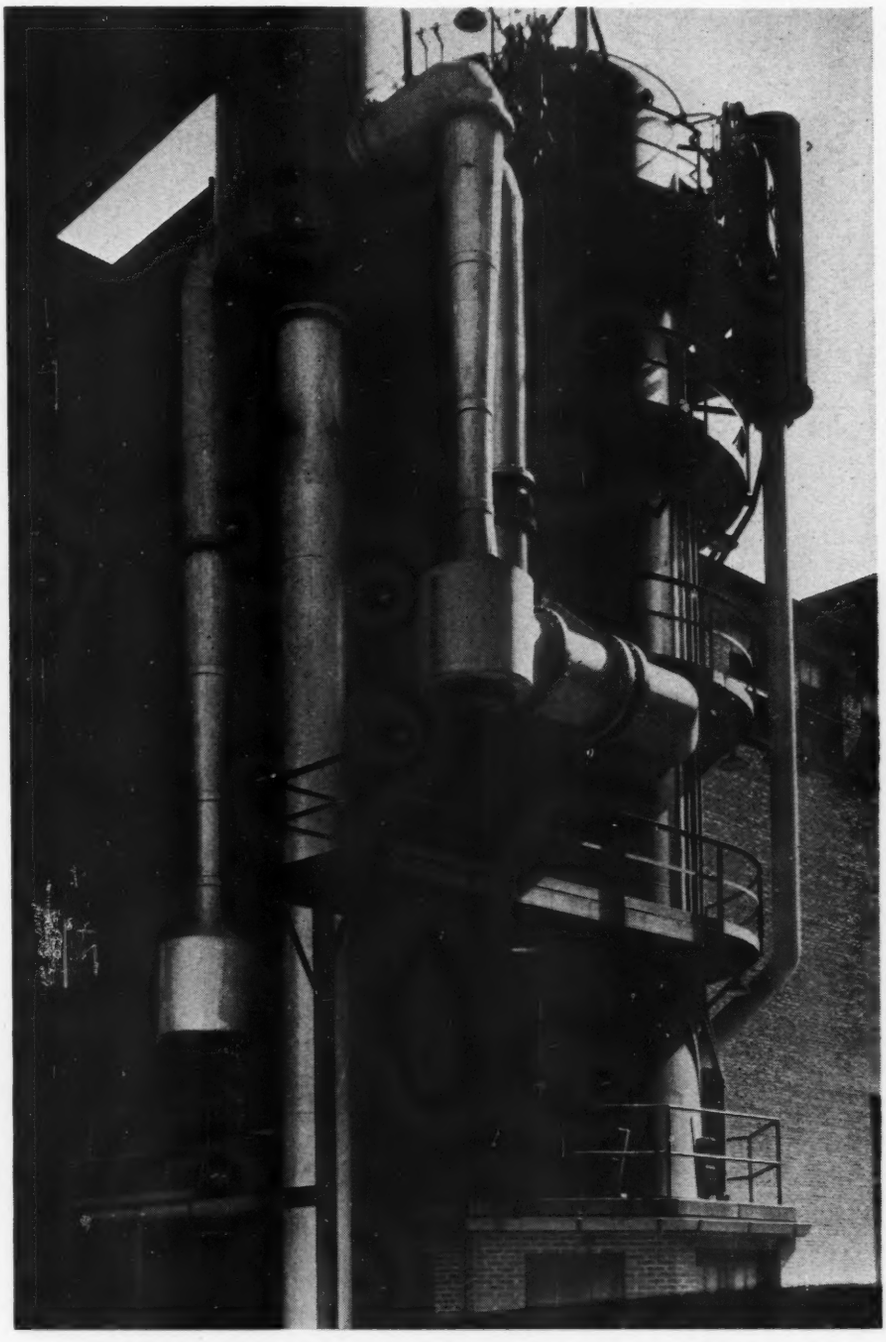
Consisting of a vertical arrangement of five separate cooling stages in a single shell, the unit cools hourly 270,000 pounds of mash at 145°F. plus 106,000 pounds of slop at 197° to a final mixture temperature of 75°. In principle, the cooler applies successively higher vacuums in the five operating stages, causing some of the water in the mash to evaporate and thus cool the remainder. A small barometric condenser equipped with two pairs of steam-jet air ejectors maintains the vacuum in the first two stages, while a larger and similar condenser, assisted by two steam-jet booster ejectors, lowers the pressure in the last three stages.

Slop at 197° entering the first stage at the top of the cooler encounters a pressure of 23.5 inches of mercury, absolute, as compared with atmospheric pressure of 29.9 inches (sea level). This lowered pressure, which corresponds to a temperature of 145°, causes water in the slop to vaporize. In so doing, heat is extracted from the remainder at the rate of about 1000 Btu's per pound of water vaporized until the temperature of the slop has dropped to 145°. Mash at the same temperature is then added, and the mixture continues to flow downward, encountering lower pressures and being cooled more and more until it emerges from the fifth stage at 75°F. Throttle valves control the degree of cooling in each stage by varying the quantity of vapors withdrawn.

In the fourth stage the temperature has been reduced to a degree near the summer temperature of the river water used in the barometric condenser. Under these conditions the condenser is unable to create sufficient vacuum to pull vapors during the fourth stage, so a booster ejector creates the necessary suction by passing steam at 230 psi. pressure through the nozzle. In winter the river water is cold enough to permit the booster to be by-passed. The high vacuum required in the fifth stage necessitates the use of a similar booster throughout the entire year. During the summer season, when the water temperature is high, the entire unit requires 7550 pounds of steam per hour and 4700 gpm. of water at 86°. Throughout the cold months, when the water temperature is 56°, it needs 2300 pounds of steam per hour and 1700 gpm. of water.

Operation of the mash cooler is completely automatic, with air-actuated controls and signaling devices installed for each stage. The flow in gallons per minute and the temperature at each stage are shown on a central control panel. Sealing between stages is effected by nozzles which make the unit self-regulating under varying load conditions. An increase in the quantity of mash flowing through the cooler causes a proportional increase in head on the nozzles, thereby raising the velocity of the mash so that the amount passing through the nozzles equals the load.

Designed to be self-cleaning, the unit is fitted with water spray nozzles for flushing the interior. Cleaning is accomplished by closing the mash and slop lines of the cooler and evacuating the interior as much as possible. Hot water at approximately 200° is then introduced. This water discharges into each stage through open end pipes and impinges on flat plates which are a part of the nozzle assembly. Some of the water vaporizes with an explosive action, breaking up the remainder into small particles. The fine mist thus produced does a thorough job of cleaning. Usually performed daily, this operation is an important function of the cooler and is in striking contrast to the tedious and time-consuming manual work normally required to eliminate stray bacteria which would interfere with proper fermentation of the mash and lower the alcoholic yield.



**DETAILS OF EQUIPMENT**

The larger of the two barometric condensers is partly visible at the top-left, with its tail pipe extending vertically to the bottom of the picture. Steam-jet booster ejectors for the fourth and fifth stages of evaporation are located right and left of it. On the far right is the smaller condenser with its descending tail pipe.

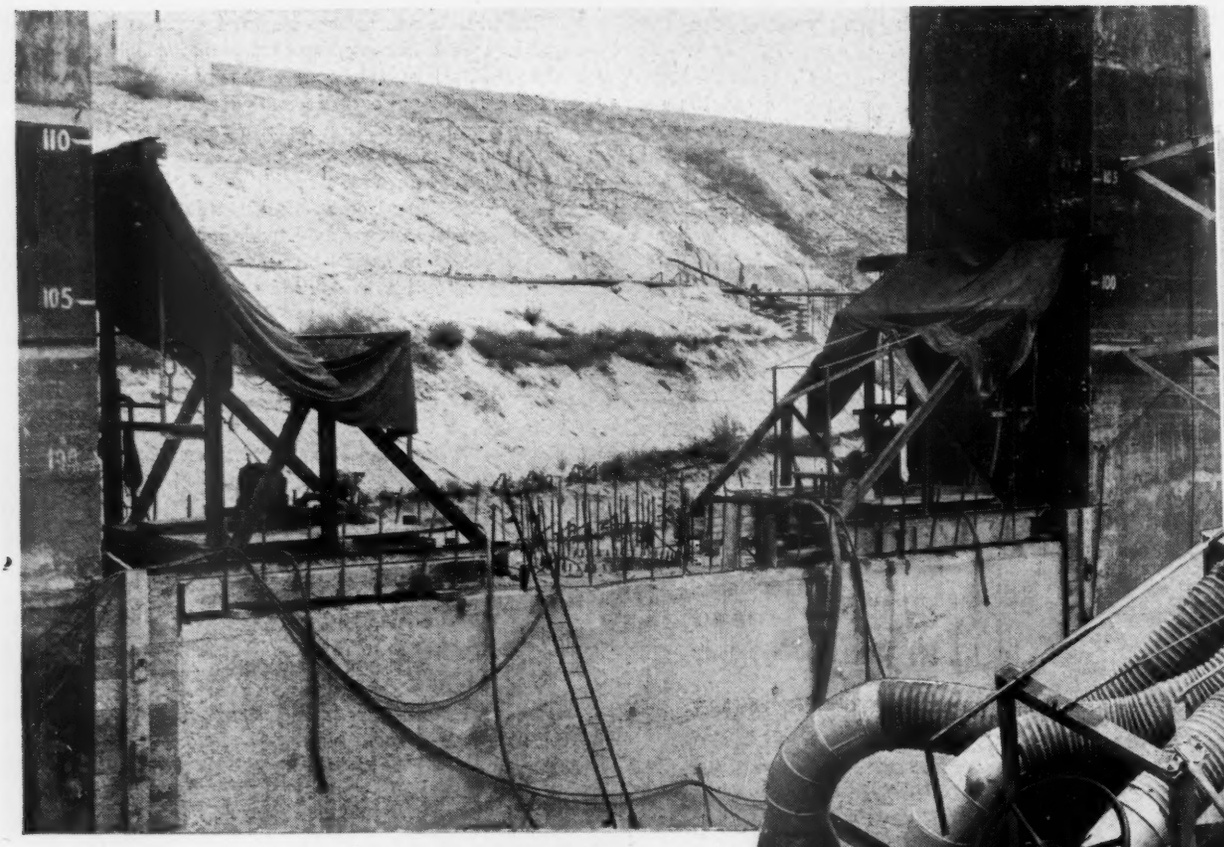



PHOTO FROM CONSTRUCTION METHODS

At the site of Neversink Dam, a unit in New York City's new Delaware River water-supply system, S. A. Healy Company is excavating a trench 2460 feet long, up to 75 feet deep, and 55 feet wide at the bottom in which a concrete cutoff wall will be placed longitudinally under the dam. In the central section of the trench, nineteen concrete caissons are being sunk through water-bearing ground to bedrock, at depths up to 90 feet. The 12x45-foot caissons are spaced 18 inches apart. After they reach a firm footing, the intervening spaces are excavated and concreted. Muck is hoisted by two Ingersoll-Rand Utility air hoists mounted on an adjoining caisson, as shown above.

# COMPRESSED AIR AT WORK

An important phase of the activities of the U. S. Bureau of Reclamation's research laboratories at Denver, Colo., is that of determining effective and economical methods of repairing structures that have deteriorated through ordinary wear and tear. In this connection, considerable experimenting is being done with materials and equipment for sealing cracks and joints in concrete. Shown at the right is an air-operated gun applying mastic to a crack in the concrete lining of the Yakima Ridge Canal on the Yakima Project in the State of Washington.

BUREAU OF RECLAMATION PHOTO

BUREAU OF RECLAMATION PHOTO

The latest device for harvesting almonds in California is the vacuum sweeper shown above. The nuts are knocked to the ground, after which the machine, which covers a 10-foot strip, picks them up by means of five suction boxes. They are drawn through connecting tubes to a bin where leaves and other debris are separated. Then they pass to a conveyor belt at the right that carries them to a bagging station at the rear. During its first test the machine gathered 300 bags of nuts a day, and its inventor, H. E. Van Till (extreme right), believes it will handle 500 bags after certain refinements are made. A driver and a sacker constitute the operating crew.

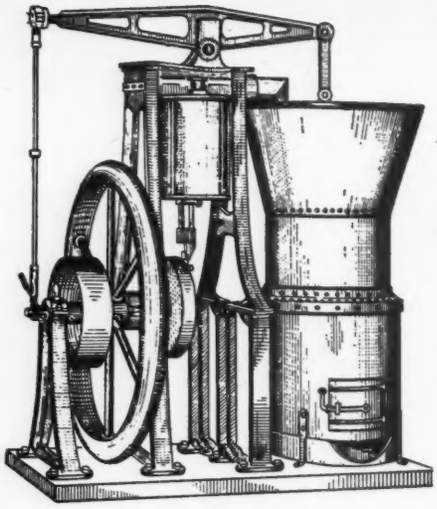
INTERNATIONAL NEWS PHOTO

William Sanborn, of Whitefish Bay, Wis., is shown above holding a device that he claims will improve the efficiency of domestic oil heating plants by from 15 to 22 percent. A multiblade rotor, resembling a miniature windmill, is fixed in the burner's fuel-injection housing. Air forced under pressure through these blades, which are stationary, is given a whirling motion before it picks up oil from the jets. The fine spray thus created results in better combustion than is possible with conventional systems.

ACME PHOTO

Our Army forces on Guam are building airplane runways as a part of the national-security program. Aggregate for the asphalt surfaces is quarried from the island's extensive deposits of coral. A member of an engineering aviation battalion is shown above at the base of a cliff drilling one of a series of holes that will be charged with explosives to bring down tons of stone. The coral is crushed and sized prior to being mixed with asphalt.

# The Philips Air Engine



**EARLY HOT-AIR ENGINE**
In the large cylinder on the right is the furnace and the hot space at the bottom, with the transfer piston above it. The smaller, central cylinder houses the working piston. The illustration is from an engraving in the journal "De Nature," 1882.

## An Old Idea Reappears in a New Form

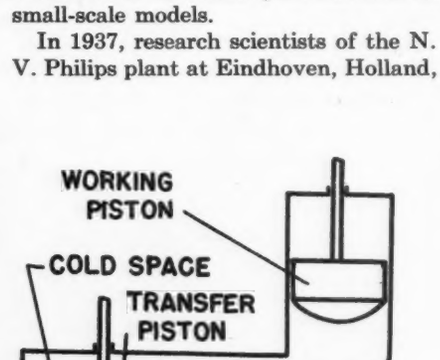
NUMEROUS attempts have been made in the past to build an engine using the expansive force of heated air as the operating medium, because a machine of this type comes closest in theoretical efficiency to the ideal heat engine based on the Carnot cycle. Perhaps the best-known example, and one that is familiar to students of thermodynamics, is the engine designed in 1816 by Robert Stirling, a Scottish clergyman. Based on sound principles, the Stirling engine, according to some engineers of that period, was destined to replace the steam engine. That it failed to do so, and, in fact, sank into obscurity, was due not to its fundamental design but to mechanical difficulties experienced with the structural materials then available. Recent advances in heat-resisting alloys and other materials have made the air engine economically feasible, and its development is now being pushed in several countries, including Holland, Great Britain, and the United States.

The air engine is operated by admitting air at high temperature and pressure into a cylinder and allowing it to perform work on a piston, thus reducing its pressure and temperature. The air is then exhausted into the atmosphere and a fresh supply introduced, or it is reheated and compressed in repetition of the first stage of the cycle. Early models were extremely bulky. Several were built in England and Scotland, but heat-transfer troubles. unsuitable regenerators, the difficulty of firing the large surfaces, and the lack of heat-resisting metals all combined to prevent their general adoption. Two Ericsson air engines, a type of American design, were constructed in 1852 for the *Ericsson*, a 1920-ton ship fitted with 32-foot-diameter paddle wheels.

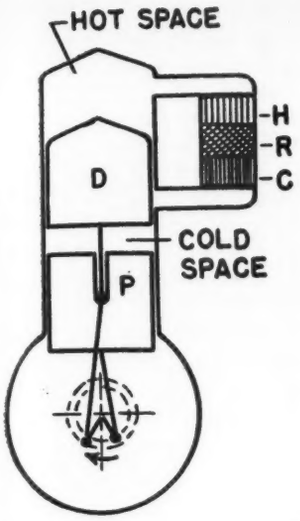
Some idea of the size of these early-day machines may be gained from the disclosure that the Ericsson engine had four cylinders each of which was 14 feet in diameter. It ran at a speed of about 9 rpm. and developed some 300 bhp. on a fuel consumption of 1.87 pounds of anthracite per horsepower-hour. After trying out two sets of air engines, the *Ericsson* was finally equipped for steam propulsion. Unable to compete with the steam engine and, later on, with gasoline and Diesel engines, the type became obsolete, remaining only in textbooks as a classical example of impractical theoretics and in the laboratory in the form of small-scale models.

In 1937, research scientists of the N. V. Philips plant at Eindhoven, Holland, turned their attention towards the air engine because of the firm's need of a small, light, and simple machine, devoid of radio-interference devices, to drive dynamos for powering its receiving and transmitting stations in regions where electricity was not available. Several small Stirling air engines were secured and submitted to the laboratory for testing. This research work, which was continued in secrecy during the German occupation, has resulted in a line of engines of extremely interesting design and characteristics ranging in size from fractional to 200 hp. Facts regarding them have been published in the *Philips Technical Review*. The extent of the improvement the type represents over the classical air engine is evident when it is considered that a 2-bhp. unit of 1923 weighed 1500 pounds and had a swept volume of 1500 cubic inches, while a modern machine of the same capacity is reported to weigh only 30 pounds and to have a displacement of but 12 cubic inches. In addition, the latter has a thermal efficiency several times greater.

Many problems had to be solved be-




**STIRLING ENGINE**
The working principle of the air engine is shown in this diagram of a model that was produced about 1840. The piston rods of both cylinders are connected to a horizontal beam that drives the crankshaft. The cooler consists of a nest of copper tubes through which cold water circulates, while the regenerator is made up of closely spaced plates of sheet iron. Compressed air at around 150 psi. pressure is initially charged into the cold space. At the up stroke of the transfer piston, air is forced from the cold space through the cooler and regenerator into the hot space, the working piston being stationary during this phase of the cycle. The air picks up some heat from the regenerator, and is further heated in the hot space. This increases the pressure of the air in the entire system, causing the working piston to move upward and to do useful work. The transfer piston then descends, forcing air out of the hot space through the regenerator and cooler. Most of its excess heat is left in the regenerator, and more is extracted by the cooler. The cool air in the upper space is then compressed on the down stroke of the working piston, after which the cycle is repeated.

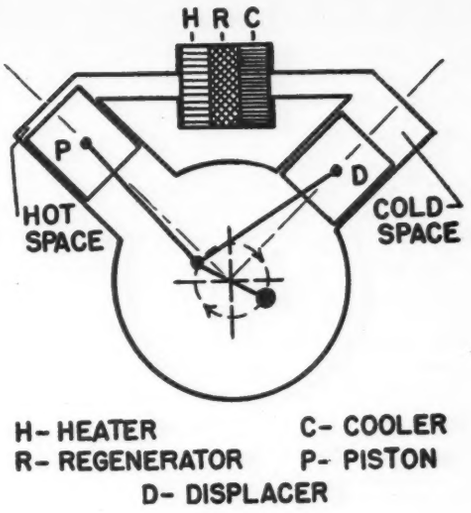


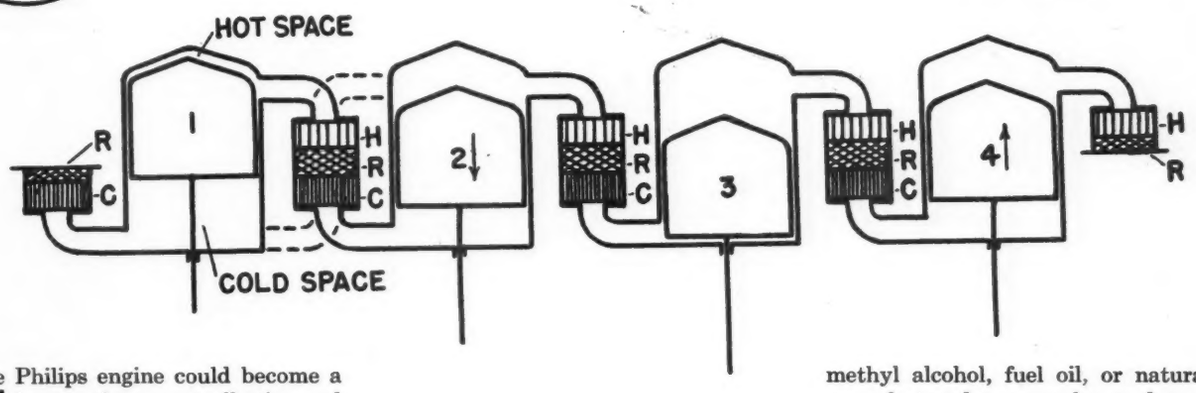

### PHILIPS-ENGINE DESIGNS

At the left is a diagram of a vertical single-cylinder air engine with the transfer piston or displacer located above the working piston. This model was designed for an output of 1 hp. at a speed of 2000 rpm.

The V-type engine at the right is made up of two cylinders set at an angle of 90° to each other. The advantages of this construction are a simplified linkage between pistons and crankshaft and the fact that the engine can be run more smoothly and with less vibration. This design is well adapted for engines of fractional horsepower.

In the multi-cylinder, 4-cycle, double-acting engine below, the transfer pistons have been eliminated by using the heater, regenerator, and cooler to connect the hot space of one cylinder with the cold space of the adjoining one. The connections, shown by dotted lines, together with a reversing slide on each cylinder, make it possible to reverse the normal direction of engine rotation.




fore the Philips engine could become a reality. Among these were effective and rapid transfer of heat and minimum resistance to the flow of air through the regenerator, heater, and cooler. Because the work performed by an engine is proportional to its speed and to the mean effective pressure, both these factors had to be high in order to realize a specific power output corresponding to that of an internal-combustion engine. Finally, it was important that the heat loss through radiation and conduction should be kept low. As the first step in achieving these ends, the laboratory workers made an analysis of the losses in the Stirling engine. Then studies were undertaken of the heat transfer involved, of air-flow resistance, and of the design and construction of regenerators.

In the new engine developed, mean effective pressures of 10 atmospheres or higher have been obtained with working speeds up to 3000 rpm. The maximum air pressure is 50 atmospheres (730 psi.), while the temperature of the hot air reaches 650°C. (1200°F). The cylinder in which external combustion takes place is well screened to safely confine the heat. Cylinder walls are made from heat-resisting steel alloys capable of standing up under high pressures as well as high temperatures, and the heater, cooler, and regenerator are constructed so as to permit efficient and rapid transfer of heat.

Of particular importance in the air engine is the regenerator, which prevents waste of heat by reclaiming it for further use. The heat which it extracts and which is then restored to the working medium is more than three times that supplied by the heater, so that without the regenerator the former would have to provide four times as much heat. Early regenerators were made of closely spaced metal plates, and the resistance they offered to the flow of air was so high that it was often considered preferable to get along without them. As a result, the amount of heat required was so great as to make the air engine too expensive to operate.

Philips has developed an entirely new type of regenerator. It consists of a coil made of finely drawn, heat-resisting wire approximately 0.002-inch in thickness. Just like the modern electric-lamp filament, which changes its temperature 60 times a second when using 60-cycle alternating current, it effects the exchange of heat with the working medium very quickly. It has been found that the unit will raise the temperature of the air flowing through it from about 100 to 600°C. (212-1112°F.) within a hundredth of a second with an efficiency of 95 percent or better while offering little resistance to the flow of air. In regard to fuel consumption per horsepower, the Philips engine occupies an intermediate place between the best gasoline engine and the Diesel.

Among the advantages of the air engine, which make it suitable for many applications, are: Gasoline, kerosene, methyl alcohol, fuel oil, or natural or manufactured gas can be used as fuel; and, as it is burned externally, combustion is complete and no carbon monoxide or other poisonous fumes are generated. Since there are no intermittent explosions in the cylinders, it runs more quietly than other machines. Wear in internal-combustion engines is primarily attributable to the high temperatures of the oil, cylinders, and pistons and to the chemical reactions resulting from contact with the gases of combustion. The cylinders and pistons of the air engine, on the other hand, are kept relatively cool and the air clean, so that this trouble is avoided. Because ignition and fuel-injection systems are not required, maintenance is simplified and it is claimed that breakdowns are less frequent than with other types. It is reported that the engine develops a high torque at low speed so that, if used to drive an automobile, the gearbox could be greatly simplified or even eliminated.

Encouraged by the progress made towards its original objective, that of designing a suitable small engine for radio-generator driving, the Philips organization is proceeding with the development of other units in various horsepower ranges. An intermediate-size, 4-cylinder, V-type engine intended for propelling road vehicles and small boats is now being tested. A new company, named N. V. Thermomotor, has been formed to develop engines larger than 200 hp. and is reportedly building a V-type unit for testing.

# Docking Seaplanes Safely

BOTH civilian and military aircraft engineers have long concerned themselves with the problem of safely landing and mooring planes on water. There is no problem, of course, when the water is calm, but high winds and choppy seas can cause serious difficulties.

Even after a plane has been set down, there still remains the task of docking it without mishap. In an effort to simplify this operation, the Navy Bureau of Yards and Docks has developed a self-propelled floating berth that has undergone successful tests at the Naval Advance Base Depot, Port Hueneme, Calif. It was described in the November, 1947, issue of *The Martin Star* published by The Glenn L. Martin Company, Baltimore aircraft manufacturer.

Built of steel pontoons, the slip can be moved along a 600-foot submerged cable and turned in any direction to permit an airplane to taxi into the wind when entering or leaving it. This relieves the pilot of the worrisome job of maneuvering especially a large plane to a dock or mooring buoy—a job that is still more troublesome as well as hazardous during bad weather.

A bell-mouthed opening at the entrance aids the pilot in steering the craft into it, and a system of water jets, three on each side, makes it possible to push the plane away from the walls and thus prevents forceful impact. In the event that it does come in contact, rows of lightly inflated airplane tires mounted horizontally on top of the dock and projecting over the inner edges safeguard the fuselage from damage.

The 134 pontoons in the assembly are arranged in three tiers or levels and are so ballasted with water that, when the structure is serving as a slip, it has only 18 inches of freeboard. It can, however, be raised so that a good part of it is out of water, which makes it easier to tow whenever it is to be moved a long distance. It can also be used in the same manner as a ship dry-dock when a plane is to be lifted out of the water for emergency repairs in places where beaching ramps are not available.

The bottom layer of the assembly consists of five parallel lines or strings of pontoons spaced a little more than 17 feet apart and tied together with horizontal and vertical trusses. There are six rectangular, boxlike pontoons in each string and a curved-face unit at each end. The second tier is made up of groups of three box pontoons mounted on both ends of the bottom strings with a slight overhang. Between the several opposed groups is a gap of approximately three pontoon lengths and forms a central channel running crosswise of the bottom strings. At right angles to the groups of three and to the bottom lines are the topmost pontoons that form the operating level. There are two strings of these on each side of the channel. Those along the outer sides of the berth have straight edges, while the inner ones curve outward from the center line to form the bell-mouthed entrance.

In over-all dimensions, the slip is 125 feet long and 52½ feet wide. The clear width of the channel at the centerline is 17½ feet. For test purposes, the Navy used Martin Mariner patrol seaplanes, and the dock was built to accommodate them. However, it was designed so that the channel might be made either narrower or wider to permit mooring other types of craft.

For self-maneuvering within the limits of the submerged cable to which it is attached, the structure has three gasoline-engine-driven propulsion units which are modifications of the wartime "Sea Mules." Two of them move the slip either forward or backward, and the third pivots it so that a plane can come in against the wind.

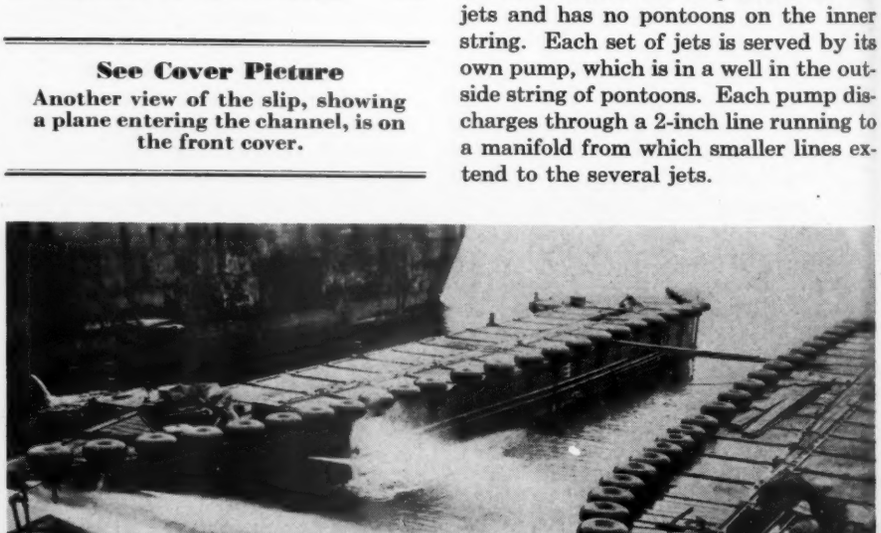
Pontoons in the top and bottom levels are either flooded or emptied to lower or raise the dock. Those in the intermediate tier are sealed watertight so as to give the structure buoyancy. The lowermost pontoons are filled with water by gravity through pipes that are swung downward for that purpose. To empty them, the pipes are swung upward and compressed-air lines are attached to remove the water by displacement. The top-deck pontoons are filled or emptied by means of pumps.

The water jets on each side of the entrance issue from nozzles with openings that taper from 2½ inches to 1 inch. They can be operated singly or in groups and can be directed horizontally through an arc of 360°. Tests have shown that the jets can maneuver a plane into the berth with such facility that even the worst kind of an approach can be turned into a safe mooring. It has been found that they are most effective when used alternately and individually rather than collectively.

The entrance end of the slip is of skeleton construction for easy access to the jets and has no pontoons on the inner string. Each set of jets is served by its own pump, which is in a well in the outside string of pontoons. Each pump discharges through a 2-inch line running to a manifold from which smaller lines extend to the several jets.

**See Cover Picture**

**Another view of the slip, showing a plane entering the channel, is on the front cover.**

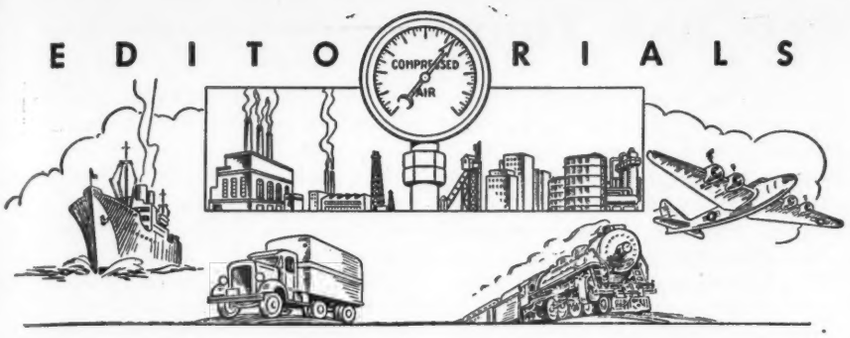


U. S. NAVY PHOTO

**THE SLIP, WITH WATER JETS IN OPERATION**

**Like a ferryboat slip, the floating dock has a wide mouth to help a pilot guide his taxiing plane into the opening. Powerful jets of water, controlled by the man at the right-center, push the hull either way, as may be necessary, to prevent it from striking the sides. If it does come in contact, the rows of inflated tires along the edges protect it against damage by scraping.**

# EDITORIALS




## OIL FIND AIDS CANADA

THE persistence of petroleum seekers in Canada has finally been rewarded by the development of the new Leduc Field just south of Edmonton, Alta. Since its discovery a year ago, a sufficient number of wells has been drilled to prove that the producing area is large enough to be classed as a major field. Its actual limits have not yet been defined, since marginal wells keep coming in. Estimates based on present knowledge indicate an eventual recovery of 100,000,000 barrels of oil over a period of twenty years.

The find was opportune, as it came at a time when Turner Valley, long Canada's most important field, was fast declining. It has also intensified the search for other oil-bearing formations in Alberta, and fifteen companies have geological parties at work. The development of more sources of petroleum in Canada would greatly improve her economic position. The Dominion now produces only about 10 percent of the oil it consumes. The remainder is imported from the United States, and in some instances is hauled as much as 2100 miles in tank cars at a maximum transportation cost of more than six cents a gallon.

The Leduc discovery was made by Imperial Oil Limited, a subsidiary of the Standard Oil Company (New Jersey). Since 1917, Imperial has spent $23,000,000 in exploration and test drilling in quest of such a field. All told, it has put down 182 wildcat wells having an aggregate depth of 170 miles. Up to the end of November it had completed seventeen wells at Leduc without getting a dry hole. Three independent companies—Globe, Leduc West, and East Leduc—also have been successful drillers and have put down the outlying wells that have progressively extended the productive area.

Leduc is already taking on an appearance of stability. An 8-mile pipe line to Nisku, the nearest railhead, is carrying about 4000 barrels of oil daily for transshipment to refineries. Meanwhile, Imperial is reërecting at Edmonton a refinery, formerly in service at Whitehorse, Yukon Territory, for the treatment of wartime petroleum obtained at Norman Wells. Dismantled into sections, the equipment was transported over the Alcan Highway to Dawson Creek and thence by rail to Edmonton. Additions to it will bring the total plant investment to around $10,000,000.

In the field itself, the new $1,500,000 townsite of Devon is taking form. It will initially number about 300 houses, not counting schools, churches, a hotel, and a motion-picture theater. Natural gas, which comes from a formation that is lower than the one yielding oil at Leduc, is being piped in by Imperial. The crude oil is of around 40° gravity and free from sulphur. Besides gasoline and other standard products, it will provide lubricants of desirable quality.

## THE WEST CELEBRATES

THE year 1948 marks the centenary of two events that vitally affected the economic growth of the nation. One of them was the discovery of gold in California, and the other the laying of the first railroad tracks westward from Chicago. Fitting observances of both these occurrences are already underway in the sections immediately concerned, and will continue during ensuing months. There is no question that the two events were definitely related.

The gold find started an irresistible surge of humanity toward the West Coast, a movement which, incidentally, is still far from being on the wane. It was a long, dangerous, and wearisome overland trek in those days. The alternate route was a still longer, expensive, and far-from-safe voyage around Cape Horn. Many of those that started across country never reached California. Some who stopped off in the Rocky Mountains began their own quests for gold and found the lodes that initiated new rushes of fortune seekers in 1859. Thus the colonization of all the vast trans-Mississippi area was speeded up, and with it came a demand for rail transportation that had to be met.

The stampede to California was touched off when James W. Marshall, a New Jersey wheelwright, chanced upon a piece of yellow metal in a millrace that he was building at Coloma, a mountain village some 50 miles west of Sacramento. This was on January 24, 1848. The mill owner was John Augustus Sutter, an immigrant who had set out for California ten years before by way of the Oregon Trail. He was given 49,000 acres of land by the Mexican Government in return for his promise to make it into a strong outpost.

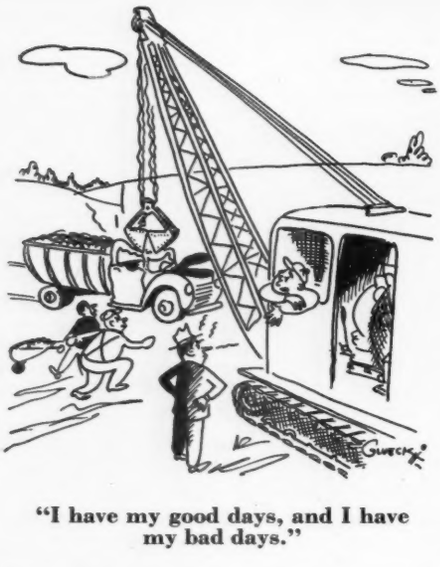
Sutter put up crude factories and workshops, cultivated the land, bought more, and became a wealthy man, with many employees. He had no need of a gold deposit, and as matters turned out would have fared far better without it. He sought to keep Marshall's discovery a secret; but this was impossible, and his land was soon overrun by hordes of wealth seekers from whom he could not protect himself. In the end, a court decision deprived him of his title to the property, and he died a bankrupt on the evening of the day in 1880 when Congress adjourned without taking action on his petition for reimbursement for his services. But where Sutter lost, thousands of others gained. Prospectors fanned out over the coastal region, uncovered fabulous mineral riches, and gave California the title of the "Golden State," which it still retains even though gold mining has long since ceased to be one of its leading industries.

Less spectacular, but of more lasting benefit, was the beginning of the western railroad network. Steam locomotives had then been in operation only a few years. There were but 8000 miles of railroad tracks in the United States. River boats, canal barges, stagecoaches, and covered wagons were the prevailing means of transportation. No tracks had reached Chicago, and the 10-ton, log-burning locomotive that made the first run out of the town was brought there on a sailing vessel. On October 25, 1848, it pulled a single car on a round trip over 5 miles of rails formed of lengths of pine reinforced by strips of oak faced with iron.

This initial railroad pointed eastward, but it had already been recognized that Chicago's destiny lay largely toward the West. The following month, a trainload of its citizens had the thrill of riding at a speed of 15 miles an hour over a line that extended 8 miles in the direction of the Pacific Ocean. At that time the immediate objective was the lead-mining district around Galena, Ill., with the Mississippi River as a future goal.

Things moved rapidly thereafter, and various railroad projects were launched. In 1852 the first train from the East pulled into Chicago; and in 1869 rails, that had been feverishly pushed from both ends, were joined by a golden spike at Promontory Point, Utah, to form the first transcontinental connection. During the intervening years the area beyond the Great Lakes has been criss-crossed by 188,525 miles of tracks, and Chicago has become the nation's greatest railroad center. It is served by 22 trunk lines, and a passenger train reaches or leaves it every 65 seconds.

# This and That



"I have my good days, and I have my bad days."

**Canadian Mineral Output Up**

By weight, Canada's 1947 mineral production was less than in 1946, but thanks to price increases during the year its value was at a record high on an annual basis. Of the total mineral output worth $619,000,000, metals accounted for $389,500,000—a gain of $100,000,000 over 1946. The removal of price controls from copper, lead, zinc, and lesser base metals in June led to sharply higher returns. By contrast, the amount received for gold was less than in 1946, but an increase in the supply of labor boosted production by 7.2 percent to 3,035,161 ounces valued at $106,200,000.

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**Gas-Filled Cables**

The practice of operating electric-circuit cables under internal gas pressure is well established. It has been applied by the American Telephone & Telegraph Company for more than twenty years and has now been extended to all its 32,000 miles of long toll cables, or "long lines." A typical cable consists of several hundred wires, insulated from one another and enclosed in a metal sheath. It is vital to continuity of service that no moisture be allowed to enter the encasement, because water reduces the effectiveness of the insulation and causes the circuits to cease functioning.

Openings in the sheath ordinarily result from electrolysis, crystallization, mechanical damage, or lightning. When such leaks occur in the case of a gas-filled cable, the internal pressure excludes moisture for several hours, or long enough to permit making repairs. Pressurization also provides a means of locating leaks, as the place where gas is escaping can be traced by what is known as the pressure-gradient technique. The gas usually used is nitrogen which, being inert, does not combine chemically with the conductors or the insulation.

Prior to charging a cable, gastight plugs are inserted in it at intervals, thus dividing it into sections which are independent of one another. A section is ordinarily from 50,000 to 60,000 feet long, but lengths varying from 25,000 feet to 34 miles have been employed. The charging pressure differs in aerial and underground, or buried, cable. The latter is initially filled to 10 psi., and nominally operates at 9 psi. Overhead cable is charged to 7 psi., and its nominal operating pressure is 6 psi. Because the primary purpose of the gas is to exclude moisture, it is necessary to establish and maintain a safe low-pressure limit. For underground cable, this has been fixed at 2 psi., which is enough to withstand a hydrostatic head of 4 feet. Because aerial cable is not subjected to water under a head, the minimum pressure for it is set at 1 psi.

To guard against pressures falling below these minima, low-pressure warning devices, called contactors, are introduced in the cable at regular intervals. Each contactor consists of a Bourdon tube, with mechanical attachments and electrical contacts. These are arranged so that they are held open by the pressure of the gas. When the pressure falls below the predetermined value, the contacts close and short circuit a pair of conductors, thus serving to operate an alarm in a nearby station. In a typical 60,000-foot gas section, conductors are placed about 5000 feet from each end, with four intermediate ones about 10,000 feet apart. Valves that permit measuring the gas pressure are spaced fairly uniformly on about 3000-foot centers and are also located at each contactor and on both sides of every gastight plug.

There is actually some gas leakage from a cable, and the pressure will drop gradually after charging. It is essential to recharge before it decreases sufficiently to actuate the contactors and sound false alarms. In order to know when to recharge, pressure readings are taken at 2- or 3-week intervals at valves spaced throughout 18,000 feet of cable. From them can be determined the rate of pressure drop and the date when recharging will be required.

Gas is admitted to the cable at equidistant points from 1½ to 2½ miles apart. It is taken to the field in cylinders that are charged to an initial pressure of 2000 psi. A reducing valve is interposed in the line leading from a cylinder to the cable and tables are used to set the valve so that the cable will be under the ultimate equalized pressure desired. The volume of gas needed for charging is established beforehand by a mathematical formula.

In the case of a break in a cable, the escaping gas will reduce the pressure until an alarm is actuated. Naturally, the pressure will be lowest at the leak and will gradually increase on both sides of it. Its approximate location can therefore be found by taking readings at the valves in the section affected and plotting them to form a pressure-gradient curve. After the leak has thus been localized, it can be definitely spotted by one of several special methods that have been developed for the purpose.

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**Wales Mines Combat Coal Dust**

Pneumatic coal picks used in South Wales coal mines are being equipped to spray water on the working face to suppress dust. Because the moil-point steel in these machines is solid, it is not feasible to introduce water through it as is done in the case of hollow rock-drill steel. Consequently, various types of external spray attachments have been developed for the picks already in service, and one manufacturer has designed an internal spray mechanism that is to be incorporated in new tools from the factory.

Virtually all the attachments for existing picks depend on a stream of compressed air to form the mist, and some of them also use it to induce suction to draw water into the device through a hose line connected with a tank or other source of supply. Circulation of dust created by the percussive action of the picking steel has in the past been ag-


"Hey! Do you realize we might lose a hammer the way you're cutting that ledge?"


**"Okay, you can be the first to help someone across the new street, but it'll be a day or two yet."**

gravated by air escaping from the exhaust ports of the tools and blowing toward the working face. This is being overcome by changing the locations of the ports so that the air will be directed away from the face.

The importance of pneumatic picks in the South Wales fields is indicated by the fact that their number increased from 356 in 1930 to 3868 in 1944, when the most recent figures were compiled. In the latter year they accounted for the mining of 4,648,823 tons of coal, or more than one-fifth of the entire production of South Wales collieries.

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**New Type of Color Microscopy**

A new technique in microscopy, which imparts characteristic colors to transparent, colorless substances, will have numerous practical applications, according to its originator, Germain C. Crossmon, a scientist of Bausch & Lomb Optical Company. Mr. Crossmon calls it "dispersion staining." Employing standard microscope equipment, and using no dyes or light filters, it is possible, by immersing materials in the correct liquid, to see each of its components in a different color. For example, in examining a thin piece of body tissue, its muscle fibers, blood vessels, and fatty tissues take on different hues.

Explaining this apparent magic, Mr. Crossmon says that the light from the microscope lamp is passed through a dark-field substage lens to strike the sample at a high angle. The sample is covered with a high-dispersion liquid that matches the light-bending power of the different materials in the sample at different portions of the color spectrum. Each material then scatters into the microscope some of the colors present in the white light, where they are seen by the observer, while other colors pass through the sample at such a high angle that they do not enter the microscope.

Possible commercial applications of the new method are: Checking foods and drugs for adulteration or contamination, and testing minerals or ores for impurities and textiles for fiber identification. Crime laboratories may find it useful in comparing fragments of materials to determine whether or not they are identical.

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**Elevators Move Most Passengers**

According to a survey made by SKF Industries, Inc., elevators transport more persons in the United States than all other forms of mass conveyance combined, including railroads, buses, streetcars, subways, and airplanes. The study indicates that seventeen billion persons ride elevators (including escalators) in a year, while buses carry around ten billion, subways four billion, railroads one billion, airplanes thirteen million, and streetcars nine million. With the addition of 5000 lifts in 1947, the nation now has nearly 400,000 elevators in service, representing a gain of 40 percent since 1927. Today's easy-riding lifts are extensive users of anti-friction bearings, there being as many as 30 steel balls in each sliding-door mechanism alone. Improvements elevator designers have in mind for the public include automatic speaking devices in department store cars that will announce the number of each floor and the merchandise available there.

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**Cost of Shale Oil Reduced**

In its experimental plant at Rifle, Colo., the U. S. Bureau of Mines is extracting oil from shale at at cost that is almost low enough to make it competitive with petroleum from wells. This was divulged to the House Appropriations Committee in Washington in December by William E. Warne, Assistant Secretary of the Interior. Present indications, he said, are that shale oil equivalent to a good low-grade crude oil can be produced for from $2.25 to $2.50 a barrel. Billions of tons of oil-bearing shales, mostly in the West and largely owned by major oil companies, are a potential source of supply. Recent increases in the price of petroleum at the wells have brought shale oil that much nearer to the status of a competitor. Meanwhile, progress has been made at Rifle in the development of low-cost methods of extracting the liquid from the shale. Research in the liquefaction of coal has not been so favorable thus far, according to Bureau of Mines reports.

**7-Mile Belt Conveyor**

Aggregates for concrete needed in building Bull Shoals Dam on the White River in Arkansas will be transported 7 miles by a conveyor system that has been exceeded in length only by the 10-mile belt used a few years ago at Shasta Dam, California. To be set up by Goodyear Tire & Rubber Company, the conveyor will be made up of sixteen sections of 31-inch-wide belting, each powered by a 100-hp. motor. Operating speed will be 525 feet per minute and carrying capacity 650 tons per hour. The four million tons of stone required will be quarried and then reduced to 8-inch maximum size for transport. Bull Shoals Dam is to be a $58,000,000 government-financed structure that is designed for purposes of flood control, irrigation, and power generation. It is being built by Ozark Constructors. Placing of concrete will begin next summer and continue for three years.

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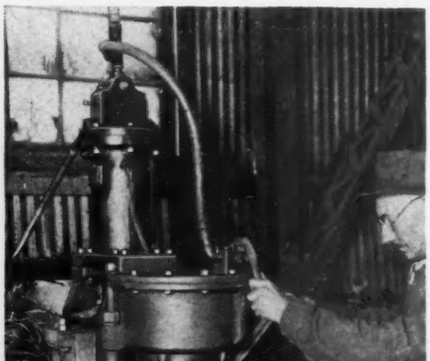
**Industry to Discuss Alcoholism**

The first national industrial conference on alcoholism will be held in Chicago on March 23. Sponsored by the Chicago Committee on Alcoholism, it is designed to acquaint industrial leaders with the facts relating to the problem of alcoholic employees and to discuss ways and means of solving it. Dr. Anton J. Carlson of the University of Chicago, who will be chairman of the conference, says the cost to industry of overdrinking among employees has been estimated to run as high as a billion dollars a year. Citing that most workers who are found to have alcoholic tendencies are discharged, he suggests another course of dealing with them. "What industry does not realize," he says, "is that time and money have been invested in these people and that it is not necessary to fire them. If proper measures are taken, most of them can be rehabilitated and, when this is accomplished, they make the best possible type of employee."

# Pneumatic Straightener Reclaims Foundry Core Rods



**STRAIGHTENING AND GAGGING**
At the left, a rod is being placed in the straightener jaws that contract in the shape of a square. The other picture shows the gagger attachment mounted on one side of the machine. The operator is forming two gaggers at one time. As the mechanism has its own control lever, piston, and air hose, it operates independently of the straightener.

A MAJOR task in many foundries is that of reclaiming the rods which bind a sand core together. These usually emerge bent and battered from a demolished core and must be straightened before they are acceptable for reuse. To eliminate laborious manual reconditioning, and to save a greater percentage of those that otherwise would be suitable only for scrap, many foundries are installing machines to do the work. One of these, built by the American Foundry Equipment Company, is air operated and straightens, shears, and forms core rods as well as bars, bolts, nails, wire, and similar material.

Rods inserted in the straightener are subjected to impacts delivered simultaneously from four sides by manganese-steel dies which close in a contracting square. The operation is controlled and the force of the blow regulated by a hand lever that actuates the throttle valve of a pneumatic cylinder. Bending jaws, projecting from the side of the machine, serve to reduce any excessive kinks before the rods are placed between the dies.

Requiring air at a minimum pressure of 60 psi., the straightener is available in four sizes capable of handling material ranging in diameter from 5/8 inch to 2 1/2 inches. It is of cast-steel construction except for the air-cylinder parts, which are of semisteel. Pistons, fitted with rings for increased efficiency, are from 4 to 9 inches in diameter and use approximately 2 to 23 cubic feet of air per minute, respectively.

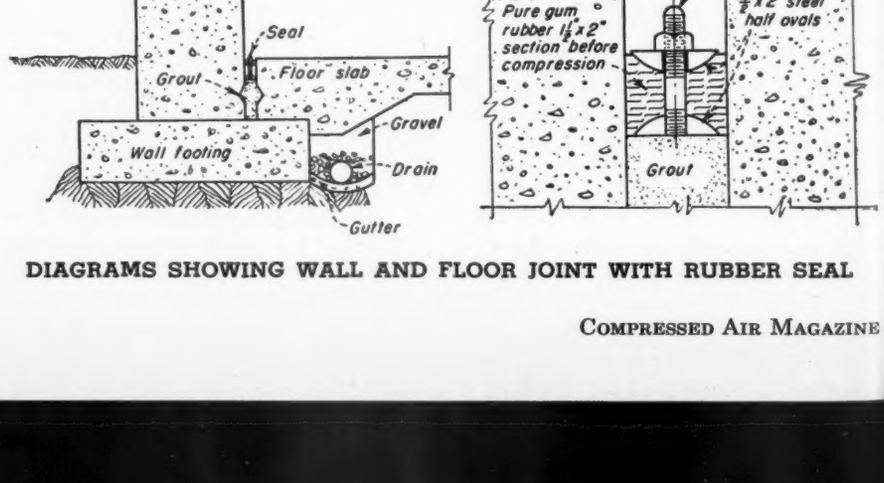
Shear jaws of hardened steel are mounted on the side of each machine and will cut material varying in thickness from 3/8 inch to 1 1/2 inches. An optional device is the gagger attachment which also may be mounted on the side of the straightener. This device gives core rods up to 5/8 inch in diameter right-angle bends to form the parts which support the upper half of a sand mold. The equipment is operated by a 12-inch-diameter pneumatic cylinder that consumes about 8 cubic feet of air per minute. Adjustable stops are provided to permit bending gaggers of uniform length.

Although designed primarily for service in foundries, the machine is suitable for use in other industrial plants where similar metal parts might be reclaimed by straightening them. It is claimed that the speed of the machine is limited only by the rate at which the operator can feed the work.

# Compressed Air Detects Leak in Reservoir

TO SERVE Oakland and vicinity with water, the East Bay municipal system maintains a series of prestressed concrete tanks that are sealed tight by a rubber filler packed between the floor slab and the wall and held in place by studs, as an accompanying cross section shows. Drains laid in gravel serve to carry off any water that may seep through the wall and floor, as well as any that may collect under the slab, and prevent undermining of the footings. Ten such reservoirs have been built since 1934 and have proved so satisfactory that five more are being constructed.

Not long ago, however, when measurements in one of the several pipes leading from the drain of the 3,000,000-gallon Joaquin Miller Reservoir indicated a loss of approximately 25 gpm., it was decided to investigate and to use compressed air to locate the defective areas. This was done by emptying the tank until the water level was 3-4 inches from the bottom and by connecting the pipe to a source of compressed air. Observers in the reservoir watched for air bubbles, and where they appeared around the filler the nuts on the studs were tightened, thus causing the rubber to expand laterally and effectually to seal the leak.



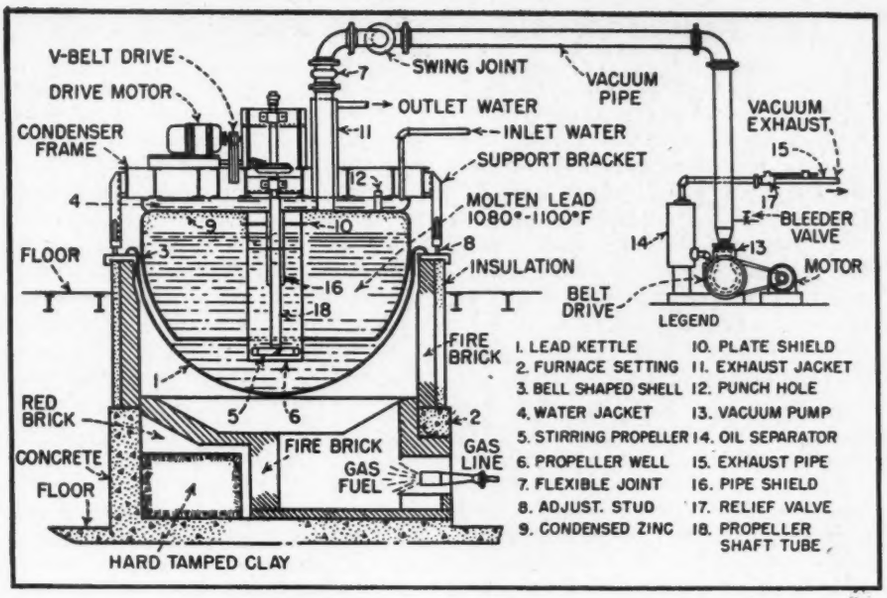

**DIAGRAMS SHOWING WALL AND FLOOR JOINT WITH RUBBER SEAL**

# Dezincing Lead Under Vacuum

AN IMPROVED method of extracting zinc from molten lead in the Parkes refining process has been developed at the Herculaneum plant of St. Joseph Lead Company and has proved to be not only practical but more economical than the one it has displaced. Lead ore always contains silver and usually small amounts of copper, zinc, and gold. The latter are removed in the course of the smelting operations, but the silver is left and must be extracted by other means. The Parkes process of refining lead makes use of the greater affinity of silver for zinc than for lead, and of the insolubility of zinc-silver alloys in lead which is already saturated with zinc. In practice, a small amount of zinc is stirred into the molten lead and the mixture is allowed to cool. The zinc rises to the surface and forms a crust which has in it nearly all the silver originally contained in the lead. This crust is then skimmed off and distilled in retorts to recover the zinc and silver.

After desilverization has been completed there remains in the lead about 0.5 or 0.6 percent of zinc, which was formerly removed by heating the lead in a reverberatory furnace. But this method had the disadvantage of oxidizing a considerable percentage of the lead as well as of the zinc, necessitating the continual collection and remelting of the fumes and dross. As a result, the substitute process of dezincing under a high vacuum was developed.

The equipment used includes a steel kettle of 120 tons capacity, a vacuum system, and a dezincing machine consisting of a bell-shaped shell or treating chamber with an agitator. The shell is 10½ feet in diameter at the top, 5⅓ feet high, and fits into the kettle. The entire upper surface of the vacuum chamber is covered with a cylindrical water jacket, and the 22-inch, 4-bladed impeller rotates within a cylindrical shroud. The propeller shaft is driven at a speed of 165 rpm. by a 15-hp. motor fitted with reduction gears and turns inside a tube that extends into the lead to a depth greater than the height of a column of molten lead equal to atmospheric pressure. This provides a liquid seal around the shaft, while a pipe shield near the top protects it from the corrosive action of the zinc. Evacuation of the treating chamber is effected by a vacuum pump connected to the shell by an 8-inch line and operated by a 25-hp. motor.




DEZINCING MACHINE COMPLETE WITH OPERATING UNIT

As soon as the desilverizing step in the lead-refining cycle is completed, the charge of 110 to 115 tons of lead is pumped into the dezincing kettle, heated to approximately 800°F., and skimmed free of froth and dross. The dezincing machine is then set in place by an overhead crane, and the water and vacuum connections are made. When the temperature has risen to 1080°, the bleeder valve is closed and the vacuum pump is started. When the pressure has fallen to 0.5 mm. of mercury, the agitator is set going. The temperature is brought up to 1100°F. and held there for the duration of the 5-hour treating time. Normally, the pressure drops to 0.05 mm. of mercury within two hours and remains at that point until the termination of the process, during which temperatures are recorded automatically and pressure readings are taken at frequent intervals.

When the dezincing machine is removed at the completion of the treatment, the zinc is found condensed in a crystalline mass on the underside of the water-cooled top of the vacuum chamber. It is loosened by vibrating the steel head with an air hammer that is fitted with a short bar having a flat, bronze head and is inserted through capped holes in the water jacket. Any zinc remaining is detached with a light chipping hammer after the shell has cooled sufficiently. The condensate is evaluated by assays and tonnage of lead treated and is reused in the desilverizing kettles. By this process the plant has recovered well over 90 percent of the zinc content left in the lead after desilverization.

The facts contained in this article are based on a paper by W. T. Isbell, superintendent, Herculaneum Division, St. Joseph Lead Company, presented at the March, 1947, meeting of the American Institute of Mining and Metallurgical Engineers.

## Lac a By-Product of Bituminous Coal

UTAH'S bituminous coal contains varying fossil resins which, when refined, are suitable for use in the manufacture of dielectric varnishes, printing inks, synthetic rubber, etc. It has been determined through research that the lac from this source has the tackiness lacking in artificial resins. As a result of these findings, there is under construction a commercial refinery with a capacity of 1 ton of concentrates per hour. The raw material will be delivered to the latter direct from the mine's washery.

In the experimental work, the coal was crushed to pass through a 6-mesh screen and delivered in batches to a mechanically agitated flotation machine. Fine grinding before separation was avoided for two reasons: it was not desirable to reduce the size of the residual coal excessively; and, as the resin is more friable than the coal, the tailings produced would have been lower in value. Furthermore, the cost of filtering and drying them would have been greater.

With 3-shift operation per day, the pilot plant handled approximately 11 tons of coal per shift, and the end product was made into pellets weighing about 40 pounds per cubic foot. Customers, however, prefer liquid resin, so a melting process was developed. Melting starts at 383°F., and when the mass reaches a temperature of 405° it is poured into steel drums. In that form it weighs 75 pounds per cubic foot. In continuous runs of long duration the furnace has reduced high-grade concentrates to a liquid state at the rate of 200 pounds per hour. The output of the new plant will depend upon the seasonal operation of the coal mine.

# Air Power Builds Better Fishing Reels

THE Langley Corporation, San Diego, Calif., has found pneumatic tools and devices of great assistance in performing precision machining operations on reels manufactured by it for fly and bait fishermen. Some parts have to be made with great accuracy to insure the fit and freedom of action desired when the reels are in service. Air-powered holding devices have been found to be superior to hand fixtures and also promote quantity production, with its lower cost.

An example of what is meant is an air chuck that holds a gear blank during a reaming operation. If a hand-tightened device were used the blank might be distorted and the finished piece, when embodied in a reel, would run noisily and unevenly. The air chuck, however, grips the blank firmly and with uniform pressure that does not lead to deformation after it is released. Every punch press in the plant is equipped with two levers as a safety measure. Both hands are required to operate them and, jointly, they control an air valve that actuates each press. With the work completed, compressed air is automatically blown upon the die to free it of chips.

Because different persons exert varying pressures in manual tightening operations, the uniform pressure exerted by compressed air is used at many stages in assembling reels. Rivets, for instance, are applied with a squeeze-type machine, while an air chuck is employed to hold a fly-reel shaft while the assembly is being screwed to the correct torque. As the shaft rides in a bearing, its smoothness must be retained, and this could not be done if it were held by a hand tool or in a vise. In addition to this advantage, the air chuck functions well-nigh instantaneously and saves time that would be lost in tightening and releasing manually operated fixtures.

## New Respiratory Filter

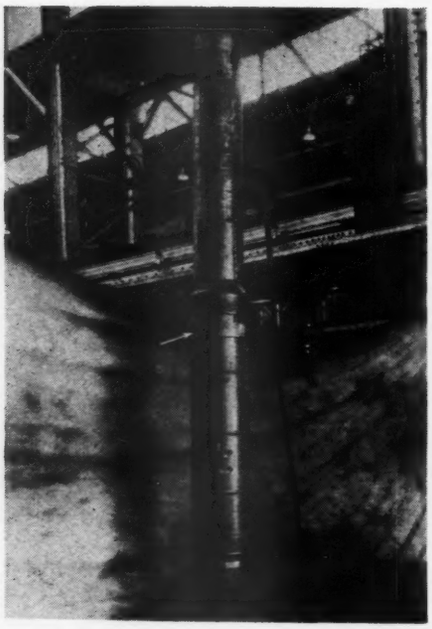
FOR the protection of industrial workers exposed to poisonous and disease-carrying dusts of infinitesimal size, the American Optical Company has produced a new respirator incorporating what is described as a revolutionary dust filter. The latter is made of chemically treated felt that is said to prevent the passage of dusts 24 millionths of an inch in diameter and less. One-eighth inch thick and slightly more than 5 square inches in area, it has the filtering capacity, according to the manufacturer, of former untreated filters of the same thickness and 42 square inches in size. To increase its service life, a gauze prefilter is used with the felt to catch large particles of dust and dirt.

The new respirator, R-2000, with filter has been approved by the U.S. Bureau of Mines and is intended to protect workers against toxic dusts such as lead, cadmium, arsenic, and chromium; pneumoconiosis-producing dusts—free silica and asbestos; and nuisance dusts like iron ore, coal, coke, limestone, etc.

**LABORATORY TEST**

This is not an Indian in war paint, but a "guinea pig" who, protected by the new respirator, was sprayed with carbon black at close range in a test chamber. How effectively the filter has prevented the material from reaching his lungs is indicated by the clear area around his mouth and the blackness of the chemically treated felt in his right hand. Because of a reduction in filtering area the respirator weighs less than those in common use and gives an increased field of vision.

## Powerful Earth Tamper Affects Large Areas



**GIANT EARTH TAMPER**

Picture at the left shows the Vibroflotation Machine at the factory of the Baldwin Locomotive Works ready for shipment to an East New York building site (right) where it is undergoing field tests. Vibration induced by an unbalanced weight in the head of the unit and jets of water issuing from the conelike structure at the bottom cause loose particles of earth throughout large areas to float and form solid ground. The hose at the right in the first view delivers the water to the cone, from which it emerges in powerful spurts as the machine sinks into the ground. To facilitate its withdrawal, water is released circumferentially at the point indicated by an arrow.

MECHANICAL tamping of unstable ground on a scale of unusual proportions is accomplished, we are advised, by equipment that had its inception in Europe and is now being tested in this country. The Vibroflotation machine, as it is called, makes use of powerful vibrations and jets of water to solidify sand or loose earth throughout large areas so it can support heavy structures.

Shaped like a streamlined rocket or missile, the unit is 13 feet long, weighs 2500 pounds, and carries in its head an electric-motor-driven vibrator consisting of a shaft with an unbalanced weight that is carried by two SKF antifriction bearings. Revolving at 1800 rpm., the weight produces a centrifugal force of 20,000 pounds, which is sufficient "at each application to pack an area of soil 100 square feet in extent to any required depth up to 100 feet into a mass solid enough to support building foundations, water-retaining dams, and heavy airport runways." The tamper can be attached to standard construction cranes.

The Vibroflotation machine in use in the United States was built by the Baldwin Locomotive Works and is being tested and developed by Parsons, Brinckerhoff, Hogan & Macdonald, consulting engineers, and by Merritt, Chapman & Scott, general contractors.

## Designer of First Wagon Drill Dies

CHARLES H. LOCHER, who was active in the construction and engineering field for 58 years, died in Glasgow, Va., on January 16 at the age of 85. One of his principal contributions to the industry was the wagon mounting for rock drills. This was truly a case of necessity being the mother of invention.

At the time, the year 1909, Mr. Locher's contracting firm of Grant Smith & Company & Locher was excavating the Livingstone Channel, part of a scheme for improving navigation on the Detroit River. The working area, which was between Grosse Isle, Mich., and Amhertsburg, Ont., had been cofferdammed at both ends to permit excavating in the dry. Underlying a shallow mantle of dirt and loose stone was limestone, which had to be drilled to depths of 12-14 feet for blasting. Three Lidgerwood aerial cables spanned the site for removal of spoil and were handling the rock faster than it could be broken.

Drilling was being done with four Ingersoll-Rand 3¼-inch-bore piston drills mounted on tripods. Holes were spaced an average of 8 feet apart, and a great deal of time was required to move the heavy rigs. Extra time was consumed in changing drill steels, because a 2-foot run was all that could be obtained with the tripod mounting. To expedite the work, Mr. Locher designed a portable mounting, consisting of a heavy timber frame on four wide-flange steel wheels. The front wheels were on a rigid axle, while the rear ones were swiveled to permit turning and steering the outfit. At the front of the platform was a vertical, heavily braced gallows frame with guides in which a drill could travel up or down. A 2-cylinder, reversible hoisting engine provided power for raising and lowering the drill and also for moving the carriage by means of a chain-and-sprocket connection to one of the front wheels. At the rear of the platform was a vertical air receiver, or "air dryer" as it was termed. Two hand-operated jackscrews at the front end took the weight off the wheels after the drill had been spotted and held the rig firmly in place.

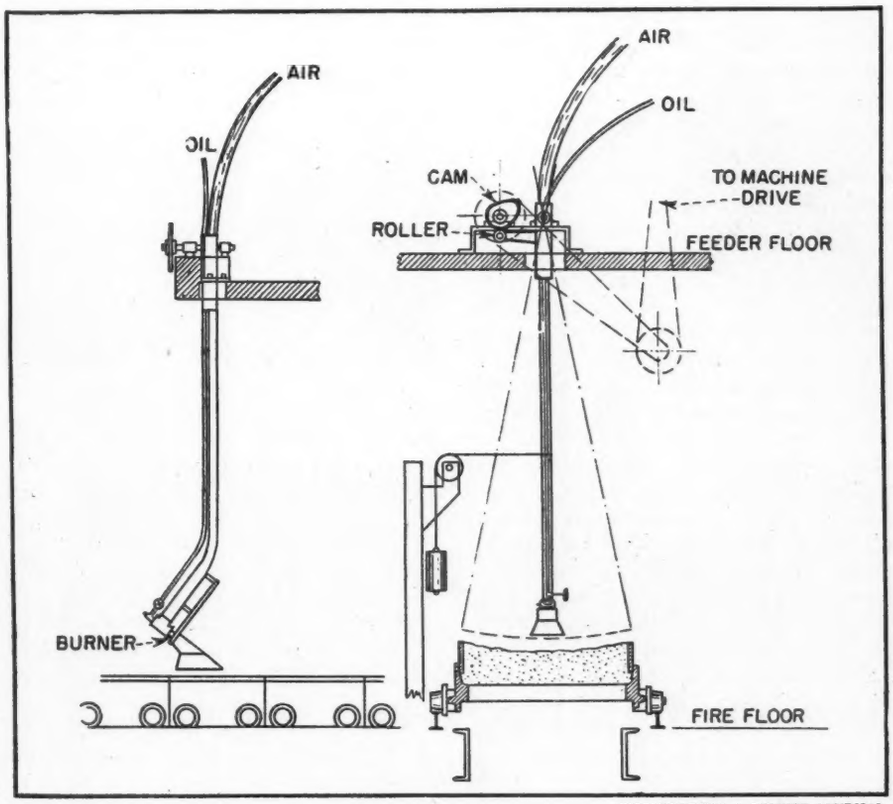
A 5-inch-bore Ingersoll-Rand rock drill was mounted on the tower, which was high enough to permit a 10-foot travel. As the rock did not cause the drill-bit gauge to wear rapidly, it was possible to drill 8 feet of hole with one steel and to put in a 14-foot hole with a one-steel change instead of the six changes that had been required with the tripod mounting. The heavier drill also increased actual footage. Penetration of around 30 feet an hour was obtained, as compared with an average of around 6 feet for the equipment previously in service. Only a minute or two was needed to move the carriage from hole to hole. After the outfit's initial success, Locher built more refined models and used steel for most of the parts that had been made of wood. From his innovation has grown the modern, highly efficient, pneumatic-tired wagon drill of today.

## Oscillating Burner Cuts Sintering Costs

THROUGH the installation of a recently patented ignition device, the Consolidated Mining & Smelting Company of Canada, Ltd., is now sintering lead concentrates at its Trail, B.C., smelter at a saving in fuel consumption of 40 percent, according to L.M.P. Davison, sintering-plant superintendent and one of the three inventors of the burner. The latter is of an oscillating type and moves back and forth across the charged grate in a plane perpendicular to the long axis of the air-supply line on which it hangs from bearings about 8 feet above the grate. The short, hot flame is played obliquely on the bed throughout its full width of 42 inches and insures proper and complete ignition.

The mechanism that drives the sintering machine also swings the burner through the medium of a cam mounted at the point of suspension. As a result, constant relationship is maintained between the forward travel of the grate and the transverse oscillation of the burner, a relationship that can be adjusted to meet the needs of the concentrate. In swinging through its arc, the burner moves steadily and slowly in one direction and as fast as possible on the return trip, and in order that the contour of the charge may conform to that of the arc, the feed end of the machine is provided with a leveling plate of like curvature. This makes the bed deeper at the edges, but as the porosity of the charge is greatest at those points, the current of air induced and drawn through tends to be uniform from one side of the grate to the other.

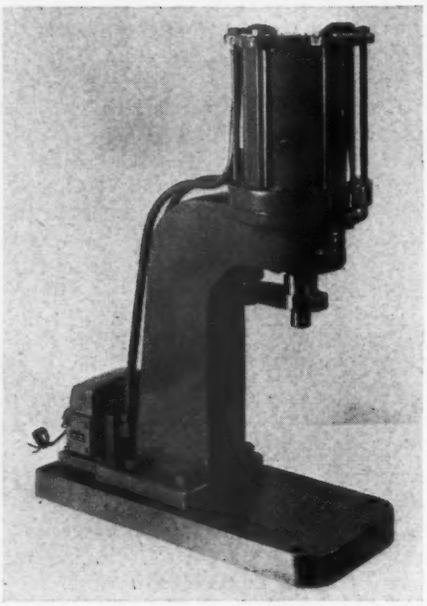
The respective interests of the inventors in the improved type of igniter have been assigned to the Consolidated Mining & Smelting Company, and as a result of the change from stationary burners the Trail smelter has been sintering 3.5 tons of lead concentrates per gallon (Imperial) of fuel oil as compared with 1.9 tons.




**SIDE AND FRONT VIEW**

Burner is swung across the traveling grate of the sintering machine by means of a cam which causes it to travel slowly in one direction to ignite the charge and fast on the return trip. Admixture of the fuel oil and atomizing air is facilitated by spiral vanes in the air passage of the burner, which is provided with a refractory-lined hood to intensify the heat of ignition. The device is protected by patents in the United States and elsewhere.

# Industrial Notes



Among the new products of Hannifin Corporation are two air-operated arbor presses in the moderate price range for light stamping, die-cutting, and marking operations, as well as for press-fit assembling in the manufacture of electric motors, small tools, bearing parts, and the like. Designated as Models M-1 and M-2, both are similar in construction, designed for bench mounting, and feature a new pushbutton-controlled electric valve that speeds up the working cycle. M-1, with a gap of 6 inches between table and ram, is equipped with a 4½-inch-diameter, 4-inch-stroke air cylinder and develops a maximum plunger pressure of 1270 pounds with air at 80 pounds line pressure. The larger unit has a 12¼-inch space between table and ram and is capable of delivering pressures up to 2650 pounds with a 6-inch-stroke, 6½-inch cylinder. The stroke in both presses can be adjusted to meet service requirements. Units are available without base for special mounting.

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Grover Company's new carrier for pneumatic-tube systems features transparency, which is an advantage over the conventional metal type because it makes the contents visible. Money or sales slips cannot be overlooked, and messages will reach their destinations quicker because dispatchers at central stations can read names and addresses without opening carriers for the purpose. The bodies of the containers are made of shatterproof Celanese celluloid and have covers with snap locks.

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You can keep your car's or truck's ignition clean, dry, and functioning in a heavy downpour and during washing by means of a "raincoat" put out by Chrysler Corporation and sold through dealers and garages. Named MoPar Evr-Dry, the synthetic-rubber cover fits over the spark plugs, thus preventing water reaching them and possible stalling. It is packed in a kit including distributor-cap nipples and a flexible-plastic ignition coil.

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Woodtrem, made by Speco, Inc., is a new preservative paint for wood. It is said to prevent rot and decay of timber buried in or in contact with the ground, and its creosote content is poisonous to bacteria. Coating is available in black and aluminum, the latter for use where a top layer of another kind of paint is to be applied.

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Victaulic Company of America has announced a new portable, automatic device that grooves plain-end pipes so that they can be used with the concern's Victaulic couplings and fittings. Known as the "Vic-Groover," it may be operated either by hand or power and is said


to cut perfect grooves to proper depth in half the time and with half the effort that it takes to thread piping. The unit is light in weight and easily carried for field work. It is available in sizes to accommodate pipes ranging from ¾ inch to 4 inches. Catalogue No. VG-47 describes the groover fully and can be obtained by writing Department P., Victaulic Company of America, 30 Rockefeller Plaza, New York 20, New York.

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Foxboro Company has announced the development of a 12-inch slide rule for computing orifice-plate bores, flow nozzles, or Venturi throats, and also the rate of flow or the differential created across the orifice plate (flange or full-flow tapped) or other primary devices. It can be used for all fluids, with or without seals, and its average error is said to be well within the accuracy of flow test data. The rule is not intended as a substitute for computation methods where purchase and sale of fluids are involved, but will be found of value in checking such calculations. It is claimed that results are obtainable in two minutes, as compared with 20 to 45 minutes by the usual procedure.

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Fiberglas sleeving suitable for insulating thermostatic switches in deep freezers, pot furnaces, and similar equipment is manufactured in a wide variety of sizes by Bentley, Harris Manufacturing Company. It serves as an extra protection for regular asbestos-covered lead wires and has an effective temperature range of minus 120 to plus 170°F. It is said to resist friction, bending, and mechanical abrasion without splitting, cracking, or fraying.

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Adhesive tape for industrial use is a new product made by Bauer & Black Division of Kendall Company. The adhesive has a backing of Fiberglas cloth and may be vulcanized to give it more than double its strength. According to the manufacturer, the tape does not shrink or stretch; resists heat, light, and deterioration; and is easy to apply. It is especially suitable for insulating, reinforcing, and sealing airtight many kinds of pressurized ducts, couplings, flues, tubes, cables, etc.

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Hydraulic-brake systems on passenger cars and trucks should occasionally be drained and refilled so as to eliminate air, moisture, dirt, or foreign liquids. The Wagner Electric Corporation makes a portable bleeder and refiller—the Fluid-Bal—which is said to speed up the operation considerably. Consisting of a spheroidal container mounted on casters, it uses compressed air from a shop's air lines to force the fluid into hydraulic-brake systems. One air charge

suffices for several car servicings. The unit is constructed of two cast-aluminum hemispheres welded together to form a pressure vessel. It has a valve for the admission of air, a pressure gauge, and a pop safety valve in the filler cap, and the outlet in the bottom is fitted with a rubber hose to transfer the brake fluid to the vehicle being serviced. Having a capacity of 2½ gallons, the container is equipped with a shut-off valve to halt the flow when the liquid drops to a level where air might enter the line. A guard rail encircling the Fluid-Bal serves as a holder for the hose when the unit is not in use.

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Unichrome Coating 218 for insulating electroplating racks and other equipment subjected to considerable mechanical abuse in service is a new product of United Chromium, Inc. In liquid form, it is applied by dipping or spraying, and is then baked at 350°F. to form a film up to ¼ inch thick when dry. It is said to be elastic and to stand up without chipping or tearing.

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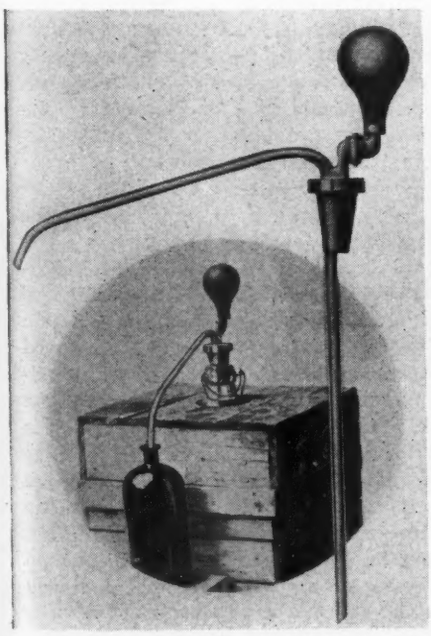
A pneumatically operated pump that safely withdraws acids and other corrosive liquids from containers is offered by General Scientific Equipment Company. It operates on the air-displacement principle, and fluid handled comes in contact only with the corrosion-resistant tubing that conveys it. The latter is of lead or flexible plastic, depending upon the liquid, and drains completely when it is removed from the carboy, drum, barrel, etc. Use of the pump obviates the need of tipping the container and reduces the possibility of spilling or splashing its contents. The device is especially useful where small amounts of corrosive liquid are required at frequent intervals, as in the case of laboratories, plating rooms, battery fill-



ing stations, and many industrial processing plants. The pump illustrated is of the hand-operated type with a bulb for building up sufficient air pressure to force the liquid from the container. A foot-controlled model also is available.

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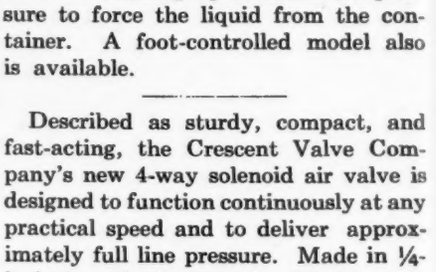
Described as sturdy, compact, and fast-acting, the Crescent Valve Company's new 4-way solenoid air valve is designed to function continuously at any practical speed and to deliver approximately full line pressure. Made in ¼-inch size only, but may be used as a substitute for some ⅜-inch valves because of its large volume output and converted to a 3-way unit by plugging one port. It is also said to operate twelve to fifteen



million cycles without requiring servicing. This, together with its small dimensions—2x6x4 inches, permits installation close to air cylinders in inaccessible places. Recommended for pressures up to 140 psi. Standard solenoids use 115-volt, 50-60 cycle, alternating current, but other voltages are obtainable. Valves are built for hand, foot, or cam operation.

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Green timber can be seasoned and hardened in a few minutes, according to Dr. Oscar Brunler, an American scientist. He says that ordinary wood presses can be adapted for the work and that either steam or electricity may be used to heat the plates. For processing 9,000,000 square feet of timber a year, the equipment would cost about $20,000. Doctor Brunler has formed a company to exploit his invention.

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Vacuum-packing of cheese in cans for curing and aging is forecast by the American Dairy Association at Washington State College. Experimental work sponsored by that organization has resulted in a process by which hard cheese can be put in ordinary steel-and-tin vacuum-type containers direct from the press. So packaged, cheese can, it is claimed, be aged for any length of time at a given temperature without damage to its texture and without the use of the valve with which metal cans ordinarily have to be equipped to permit the escape of gases generated by the cheese during curing.

# Industrial Literature

A 6-page bulletin describing a new-model electric fork truck for factory and warehouse use may be obtained from the Crescent Truck Company, Lebanon, Pa.

Norton Company, Worcester 6, Mass., has prepared a 74-page booklet discussing the subject of injury to metal surfaces by grinding. Toolmakers, metallurgists, and others concerned with finished surfaces of ground steel may find it helpful.

Dimensional data and descriptions of welding fittings from ¾ inch to 12 inches and of lightweight flanges from ¾ inch to 30 inches are contained in Bulletin 476 of the Taylor Forge & Pipe Works, P. O. Box 485, Chicago 90, Ill.

Bulletin No. 150 issued by American Air Filter Company, Inc., 215 Central Avenue, Louisville, Ky., describes the construction and application of the firm's self-cleaning air filter for engine and compressor service.

A 12-page catalogue dealing with industrial protective clothing may be had from The B. F. Goodrich Company, Akron, Ohio. The publication describes and illustrates aprons, suits, coats, leggings, hats, and gloves made of rubber and synthetic materials.

Typical applications of Dow Corning Corporation's DC-710 silicone lubricating oil, designed for use at temperatures between 10 and 500°F., are set forth in a recent issue of *Silicone Notes*, copies of which may be obtained by writing to the firm at Midland, Mich.

Bulletin No. 1001 of the Pokorney Manufacturing Company, 3117 Clybourn Avenue, Chicago, Ill., describes a new check valve it has recently introduced. Piston operated and spring loaded, the valve is reported to provide a positive check on water, oil, air, or gas.

Sinclair-Collins Valve Company, 454 Morgan Avenue, Akron 11, Ohio, has issued a 20-page bulletin describing the firm's line of control valves for steam, air, liquids, and gas. The valves are direct- or reverse-acting and cover a range of pressures from 0 to 250 psi. Charts are included in the booklet to aid in the selection of the proper size.

Users of electric-welding equipment may secure from the Tweco Products Company, Wichita 1, Kans., a catalogue describing the company's line of cable connections, splicers, and electrode holders. There is also available a service bulletin covering some causes of and cures for hot-running welding cables and connections.

A circular outlining the organization and functions of the National Inventors Council may be secured from the Department of Commerce, Washington 25, D. C. Private citizens are encouraged to submit inventions and ideas which they believe will contribute to national defense and welfare, and the council acts as a clearing house for the proposals.

Reinhold Publishing Corporation has announced that the 1947-48 edition of the *Chemical Engineering Catalog* is now available. This 32nd edition is a source of condensed and standardized data about equipment, machinery, raw materials, heavy and fine chemicals, and laboratory supplies for industries using chemical processes of manufacture. Cross-referenced, classified indices are provided for all material in the 1584-page volume, as well as a section cataloging and briefly describing a list of selected books on chemical and related subjects. Copies and further information may be obtained by writing to the publisher at 330 West 42nd Street, New York 18, N. Y.

Farris Engineering Corporation, 547 Commercial Avenue, Palisades Park, N. J., has issued Bulletin No. 50 containing, in condensed form, specifications which permit the prompt selection of relief and safety valves. Sizes, pressures, and materials of construction are included, as well as sectional drawings of 31 different types.

A 48-page handbook on hydraulic oils is obtainable from E. F. Houghton & Company, 303 West Lehigh Avenue, Philadelphia 33, Pa. Containing diagrams, tables, and illustrations, the handbook gives specifications and qualities which a good hydraulic oil must possess. A chapter on trouble shooting is included for the benefit of those charged with the proper maintenance of hydraulic systems.

Descriptive literature covering the Nugent line of oil filters for fuel and lubricating systems of internal-combustion engines may by obtained from Wm. W. Nugent & Company, Inc., 410-12 North Hermitage Avenue, Chicago 22, Ill. The concern manufactures a full line of filters in both the bag and absorbent type, either single- or double-acting for full-flow or by-pass filtering.

*Lubrication of Underground Mining Machinery* is the title of an article in the January issue of "Lubrication" published by The Texas Company. Information concerning the lubrication of compressors, rock drills, pumps, loading and cutting machines, mine cars, and conveyors is given in the magazine, a copy of which may be obtained free of charge by writing to the company at 135 East 42nd Street, New York 17, N. Y.

Mine Safety Appliances Company, Pittsburgh 8, Pa., has published information about its newly designed velocity power driver. Known as the Model B, the tool uses the energy confined in a small blank cartridge to drive studs into concrete or structural steel for the purpose of anchoring pipe hangers, conduit boxes, heating and ventilating ducts, and other industrial equipment.

Detailed information about the Sagem tool-room microscope, a European model now available in the United States, may be secured from E. Leitz, Inc., 304 Hudson Street, New York 13, N. Y. The instrument is designed to provide a means of checking gages, jigs, taps, and other tools, as well as to inspect surfaces for cracks, roughness, porosity, and Brinnel impressions.

Ingersoll-Rand Company, 11 Broadway, New York 4, N. Y., has issued two new bulletins describing its line of heavy-duty compressors. Form 3262-B covers the direct-connected, synchronous-motor-driven XRE type and the XRB and XCB belted-motor-driven models. These machines range in size from 75 to 300 hp. and in capacity from 400 to 1000 cubic feet of free air per minute delivered at 100 psi. pressure. Form 3063-D deals with the Class ES compressor run by steam, by V- or flat-belt drive, or by direct-connected synchronous motor. These units range in size from 15 to 125 hp. and deliver air at from 5 to 2500 psi. in one, two, or three stages.


As metalworking goes, so goes the nation's economic health. The Metalworking industries, representing over one-third of all American industry, are probably more responsible than any other segment of industry for the country's economic recovery and continued prosperity, since they cover both the capital goods and consumer goods markets.

BURNHAM FINNEY
Editor, American Machinist

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